UNIFORM BUILDING CODE

1952 Edition

Volume 1

Pacific Coast
Building Officials Conference

124 West Fourth Street
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Preface

¶ The Uniform Building Code is dedicated to the development of better building construction and greater safety to the public, through the elimination of needless red tape, favoritism and local politics by uniformity in building laws; to the granting of full justice to all building materials on the fair basis of the true merits of each material; and to the development of a sound economic basis for the future growth of cities through unbiased and equitable dealing with structural design and fire hazards.

OUTLINE OF CONTENTS BY PARTS, CHAPTERS AND SECTIONS

The Uniform Building Code

was first published by the Pacific Coast Building Officials Conference at the Sixth Annual Business Meeting held in Phoenix, Arizona, October 18-21, 1927.

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New Editions of this Code have been published in 1930, 1933, 1937, 1940, 1943, 1946 and 1949, following official action on the floor of Annual Business Meetings.

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The 1952 (Ninth) Edition of the Uniform Building Code is a revision of the 1949 Edition, with Revisions, Additions and Amendments approved by the Active Members at the Twenty-Seventh, Twenty-Eighth and Twenty-Ninth Annual Business Meetings of the Pacific Coast Building Officials Conference.

Pacific Coast Building Officials Conference

UNIFORM BUILDING CODE

Ordinance No.....

An ordinance regulating the erection, construction, enlargement, alteration, repair, moving, removal, conversion, demolition, occupancy, equipment, use, height, area, and maintenance of buildings or structures in the City of .....; providing for the issuance of permits and collection of fees therefor; declaring and establishing Fire Districts; providing penalties for the violation thereof, and repealing all ordinances and parts of ordinances in conflict therewith.

Be it ordained by the.....

of the City of.....as follows:

PART I

ADMINISTRATIVE

CHAPTER 1—TITLE AND SCOPE

Title

Sec. 101. This ordinance shall be known as the "Building" Code," may be cited as such, and will be referred to herein as "this Code."

Purpose

Sec. 102. The purpose of this Code is to provide minimum standards to safeguard life or limb, health, property, and public welfare by regulating and controlling the design, construction, quality of materials, use and occupancy, location and maintenance of all buildings and structures within the city and certain equipment specifically regulated herein.

Wherever in this Code reference is made to the Appendix, the provisions in the Appendix shall not apply unless specifically adopted.

Scope

Sec. 103. New buildings and structures hereafter erected in the city, and buildings and structures moved into or within the city shall conform to the requirements of this Code.

Additions, alterations, repairs and changes of use or occupancy in all buildings and structures shall comply with the provisions for new buildings and structures except as otherwise provided in Sections 104, 306, and 502 of this Code.

Where, in any specific case, different sections of this Code specify different materials, methods of construction or other requirements, the most restrictive shall govern.

Application to Existing Buildings

Sec. 104. (a) **General.** Buildings or structures to which additions, alterations, or repairs are made shall comply with all the requirements for new buildings or structures except as specifically provided in this Section.

For construction in Fire Zones see Chapter 16.

(b) **Additions, Alterations and Repairs: More Than 50 Per Cent.** When additions, alterations, or repairs within any 12-month period exceed 50 per cent of the value of an existing building or structure, such building or structure shall be made to conform to the requirements for new buildings or structures.

(c) **Additions, Alterations, and Repairs: 25 to 50 Per Cent.** Additions, alterations, and repairs exceeding 25 per cent but not exceeding 50 per cent of the value of an existing building or structure and complying with the requirements for new buildings or structures may be made to such building or structure within any 12-month period without making the entire building or structure comply. The new construction shall conform to the requirements of this Code for a new building of like area, height, and occupancy. Such building or structure, including new additions, shall not exceed the areas and heights specified in this Code.

(d) **Additions, Alterations and Repairs: 25 Per Cent or Less.** Structural additions, alterations, and repairs to any portion of an existing building or structure, within any 12-month period, not exceeding 25 per cent of the value of

Application to Existing Buildings (Cont'd.)

the building or structure shall comply with all of the requirements for new buildings or structures, except that minor structural additions, alterations, or repairs, when approved by the Building Official, may be made with the same material of which the building or structure is constructed. Such building or structure, including new additions, shall not exceed the areas and heights specified in this Code.

(e) **Non-Structural Alterations and Repairs: 25 Per Cent or Less.** Alterations or repairs, not exceeding 25 per cent of the value of an existing building or structure, which are non-structural and do not affect any member or part of the building or structure having required fire resistance, may be made with the same materials of which the building or structure is constructed.

(f) **Repairs: Roof Covering.** Not more than 25 per cent of the roof covering of any building or structure shall be replaced in any 12-month period unless the new roof covering is made to conform to the requirements of this Code for new buildings or structures.

(g) **Existing Occupancy.** Buildings in existence at the time of the passage of this Code, may have their existing use or occupancy continued, if such use or occupancy was legal at the time of the passage of this Code, provided such continued use is not dangerous to life.

Any change in the use or occupancy of any existing building or structure shall comply with the provisions of Sections 306 and 502.

(h) **Moved Buildings.** Buildings or structures moved into or within the city shall comply with the provisions of this Code. See Section 1601 (c) for requirements in Fire Zones.

(i) **Maintenance.** All buildings or structures both existing and new, and all parts thereof, shall be maintained in a safe and sanitary condition. All devices or safeguards which are required by this Code in a building or structure when erected, altered, or repaired, shall be maintained in good working order. The owner or his designated agent shall be responsible for the maintenance of buildings and structures.

Alternate Materials and Methods of Construction

Sec. 105. The provisions of this Code are not intended to prevent the use of any material or method of construction not specifically prescribed by this Code, provided any such alternate has been approved.

The Building Official may approve any such alternate provided he finds that the proposed design is satisfactory and complies with the provisions of Chapter 23, and that the material, method, or work offered is, for the purpose intended, at least the equivalent of that prescribed in this Code in quality, strength, effectiveness, fire resistance, durability, and safety.

The Building Official shall require that sufficient evidence or proof be submitted to substantiate any claims that may be made regarding its use.

Tests

Sec. 106. Whenever there is insufficient evidence of compliance with the provisions of this Code or evidence that any

material or any construction does not conform to the requirements of this Code, or in order to substantiate claims for alternate materials or methods of construction, the Building Official may require tests as proof of compliance to be made at the expense of the owner or his agent by an approved agency. **Tests (Cont'd.)**

Test methods shall be as specified by this Code for the material in question. If there are no appropriate test methods specified in this Code, the Building Official shall determine the test procedure.

Copies of the results of all such tests shall be retained for a period of not less than two years after the acceptance of the structure.

CHAPTER 2—ORGANIZATION AND ENFORCEMENT

Creation of Department

Sec. 201. There is hereby established in the city the "Building Department" which shall be under the jurisdiction of the Building Official designated by the appointing authority.

Powers and Duties of Building Official

Sec. 202. (a) **General.** The Building Official is hereby authorized and directed to enforce all the provisions of this Code. For such purpose he shall have the powers of a police officer.

The determination of value or valuation under any of the provisions of this Code shall be made by the Building Official.

(b) **Deputies.** In accordance with the procedure and with the approval of the chief appointing authority of the municipality, the Building Official may appoint such number of officers, inspectors and assistants and other employees as shall be authorized from time to time. He may deputize such employees as may be necessary to carry out the functions of the Building Department.

(c) **Reports and Records.** The Building Official shall submit a report to the proper city official not less than once a year, covering the work of the department during the preceding period. He shall incorporate in said report a summary of his recommendations as to desirable amendments to the law.

The Building Official shall keep a permanent, accurate account of all fees and other monies collected and received under this Code, the names of the persons upon whose account the same were paid, the date and amount thereof, together with the location of the building or premises to which they relate.

(d) **Right of Entry.** Upon presentation of proper credentials the Building Official or his duly authorized representatives may enter at reasonable times any building, structure or premises in the city to perform any duty imposed upon him by this Code.

(e) **Stop Orders.** Whenever any building work is being done contrary to the provisions of this Code, the Building Official may order the work stopped by notice in writing served on any persons engaged in the doing or causing such work to be done, and any such persons shall forthwith stop such work until authorized by the Building Official to proceed with the work.

Unsafe Buildings

Sec. 203. (a) **General.** All buildings or structures which are structurally unsafe or not provided with adequate egress, or which constitute a fire hazard, or are otherwise dangerous to human life, or which in relation to existing use constitute a hazard to safety or health, or public welfare, by reason of inadequate maintenance, dilapidation, obsolescence, or abandonment, as specified in this Code or any other effective ordinance, are, for the purpose of this Section, unsafe buildings. All such unsafe buildings are hereby declared to be public nuisances and shall be abated by repair, rehabilitation, demolition, or removal in accordance with the procedure of this Section.

Unsafe Buildings (Cont'd.)

(b) **Notice to Owner.** The Building Official shall examine or cause to be examined every building or structure or portion thereof reported as dangerous or damaged and, if such is found to be an unsafe building as defined in this Section, the Building Official shall give to the owner of such building or structure written notice stating the defects thereof. This notice may require the owner or person in charge of the building or premises, within 48 hours, to commence either the required repairs or improvements or demolition and removal of the building or structure or portions thereof, and all such work shall be completed within 90 days from date of notice, unless otherwise stipulated by the Building Official. If necessary, such notice shall also require the building, structure, or portion thereof to be vacated forthwith and not reoccupied until the required repairs and improvements are completed, inspected, and approved by the Building Official.

Proper service of such notice shall be by personal service upon the owner of record, if he shall be found within the city limits. If he is not found within the city limits such service may be made upon said owner by registered mail; provided, that if such notice is by registered mail, the designated period within which said owner or person in charge is required to comply with the order of the Building Official, shall begin as of the date he receives such notice.

(c) **Posting of Signs.** The Building Official shall cause to be posted at each entrance to such building a notice to read: "DO NOT ENTER. UNSAFE TO OCCUPY. Building Department, City of....." Such notice shall remain posted until the required repairs, demolition, or removal is completed. Such notice shall not be removed without written permission of the Building Official and no person shall enter the building except for the purpose of making the required repairs or of demolishing the building.

(d) **Right to Demolish.** In case the owner shall fail, neglect, or refuse to comply with the notice to repair, rehabilitate, or to demolish and remove said building or structure or portion thereof, the City Council may order the owner of the building prosecuted as a violator of the provisions of this Code and may order the Building Official to proceed with the work specified in such notice. A statement of the cost of such work shall be transmitted to the City Council, who shall cause the same to be paid and levied as a special assessment against the property.

(e) **Costs.** Costs incurred under Subsection (d) shall be paid out of the City Treasury. Such costs shall be charged to the owner of the premises involved as a special assessment on the land on which the building or structure is located, and shall be collected in the manner provided for special assessments.

Board of Appeals

Sec. 204. In order to determine the suitability of alternate materials and types of construction and to provide for reasonable interpretations of the provisions of this Code, there shall be and is hereby created a Board of Appeals, consisting of five members who are qualified by experience and training to pass upon matters pertaining to building construction.

Board of Appeals (Cont'd.)

The Building Official shall be an ex-officio member and shall act as Secretary to the Board. The Board of Appeals shall be appointed by the Mayor and shall hold office at his pleasure. The Board shall adopt reasonable rules and regulations for conducting its investigations and shall render all decisions and findings in writing to the Building Official with a duplicate copy to the appellant and may recommend to the City Council such new legislation as is consistent therewith.

Violations and Penalties

Sec. 205. It shall be unlawful for any person, firm or corporation to erect, construct, enlarge, alter, repair, move, improve, remove, convert or demolish, equip, use, occupy or maintain any building or structure in the city, or cause the same to be done, contrary to or in violation of any of the provisions of this Code.

Any person, firm or corporation violating any of the provisions of this Code shall be deemed guilty of a misdemeanor, and each such person shall be deemed guilty of a separate offense for each and every day or portion thereof during which any violation of any of the provisions of this Code is committed, continued or permitted, and upon conviction of any such violation such person shall be punishable by a fine of not more than $300, or by imprisonment for not more than 90 days, or by both such fine and imprisonment.

CHAPTER 3—PERMITS AND INSPECTIONS

Application for Permits

Sec. 301. (a) **Permits Required.** No person, firm or corporation shall erect, construct, enlarge, alter, repair, move, improve, remove, convert or demolish any building or structure in the city, or cause the same to be done, without first obtaining a separate building permit for each such building or structure from the Building Official.

(b) **Application.** To obtain a permit the applicant shall first file an application therefor in writing on a form furnished for that purpose. Every such application shall:

1. Describe the land on which the proposed work is to be done, by lot, block, tract, and house and street address, or similar description that will readily identify and definitely locate the proposed building or work;
2. Show the use or occupancy of all parts of the building;
3. Be accompanied by plans and specifications as required in Subsection (c) of this Section;
4. State the valuation of the proposed work;
5. Be signed by the permittee, or his authorized agent, who may be required to submit evidence to indicate such authority.
6. Give such other information as reasonably may be required by the Building Official.

(c) **Plans and Specifications.** Each application for a permit shall be accompanied by two sets of plans and specifications.

EXCEPTION: Plans and specifications need not be submitted for small and unimportant work when authorized by the Building Official.

(d) **Information on Plans and Specifications.** Plans and specifications shall be drawn to scale upon substantial paper or cloth and shall be of sufficient clarity to indicate the nature and extent of the work proposed and show in detail that it will conform to the provisions of this Code and all relevant laws, ordinances, rules and regulations. The first sheet of each set of plans shall give the house and street address of the work and the name and address of the owner and person who prepared them. Plans shall include a plot plan showing the location of the proposed building and of every existing building on the property. In lieu of detailed specifications, the Building Official may approve references on the plans to a specific section or part of this Code or other ordinances or laws.

Computations, stress diagrams, and other data sufficient to show the correctness of the plans, shall be submitted when required by the Building Official.

Building Permits

Sec. 302. (a) **Issuance.** The application, plans and specifications filed by an applicant for a permit shall be checked by the Building Official. Such plans may be reviewed by other departments of the city to check compliance with the laws and ordinances under their jurisdiction. If the Building Official is satisfied that the work described in an application for permit and the plans filed therewith conform to the requirements of this Code and other pertinent laws and ordinances, and that the fee specified in Section 303 (a) has been paid, he shall issue a permit therefor to the applicant.

Building Permits (Cont'd.)

When the Building Official issues the permit, he shall endorse in writing or stamp on both sets of plans and specifications "APPROVED." Such approved plans and specifications shall not be changed, modified or altered without authorization from the Building Official, and all work shall be done in accordance with the approved plans.

(b) **Retention of Plans.** One set of approved plans, specifications and computations shall be retained by the Building Official for a period of not less than 90 days from date of completion of the work covered therein, and one set of approved plans and specifications shall be returned to the applicant, which set shall be kept on such building or work at all time during which the work authorized thereby is in progress.

Plans, submitted for checking, for which no permit is issued, and on which no action is taken by the applicant for 90 days, shall be returned to the last known address of the applicant; to renew action on said plans, a payment of a new plan check fee shall be required.

(c) **Validity.** The issuance or granting of a permit or approval of plans and specifications shall not be construed to be a permit for, or an approval of, any violation of any of the provisions of this Code. No permit presuming to give authority to violate or cancel the provisions of this Code shall be valid, except in so far as the work or use which it authorizes is lawful.

The issuance of a permit based upon plans and specifications shall not prevent the Building Official from thereafter requiring the correction of errors in said plans and specifications or from preventing building operations being carried on thereunder when in violation of this Code or of any other ordinance of the city.

(d) **Expiration.** Every permit issued by the Building Official under the provisions of this Code shall expire by limitation and become null and void, if the building or work authorized by such permit is not commenced within 60 days from the date of such permit, or if the building or work authorized by such permit is suspended or abandoned at any time after the work is commenced for a period of 60 days. Before such work can be recommenced a new permit shall

Fees

TABLE NO. 3-A—BUILDING PERMIT FEES

TOTAL VALUATION	FEE
Less than $20.00	No Fee
$20.00 to and including $100.00	$1.00
More than $100.00, to and including $400.00	2.00
More than $400.00, to and including $700.00	4.00
More than $700.00, to and including $1,000.00	6.00
Each additional $1,000.00 or fraction, to and including $15,000.00	2.00
Each additional $1,000.00 or fraction, to and including $50,000.00	1.00
Each additional $1,000.00 or fraction exceeding $50,000.00	0.50

Fees (Cont'd.)

be first obtained so to do, and the fee therefor shall be one-half the amount required for a new permit for such work, provided no changes have been made or will be made in the original plans and specifications for such work; and provided, further, that such suspension or abandonment has not exceeded one year.

Sec. 303. (a) **Building Permit Fees.** A fee for each building permit shall be paid to the Building Official as set forth in Table No. 3-A.

Where work for which a permit is required by this Code is started or proceeded with prior to obtaining said permit, the fees above specified shall be doubled, but the payment of such double fee shall not relieve any persons from fully complying with the requirements of this Code in the execution of the work nor from any other penalties prescribed herein.

(b) **Plan-checking Fees.** Before plans and specifications are accepted for checking, a plan-checking fee in addition to the building permit fee shall be paid to the Building Official. The plan-checking fee shall be one half the building permit fee.

EXCEPTIONS: A plan-checking fee shall not be required for:

1. Buildings or structures whose total valuation is less than $5,000.00;
2. Buildings of stud bearing wall construction with no floor or roof span in excess of twenty-four feet (24');
3. Alterations and repairs of a non-structural nature.

Inspections

Sec. 304. (a) **General.** All construction or work for which a permit is required shall be subject to inspection by the Building Official, and certain types of construction shall have continuous inspection by special inspectors, as specified in Section 305.

(b) **Inspection Record Card.** Work requiring a building permit shall not be commenced until the permit holder or his agent shall have posted an inspection record card in a conspicuous place on the front premises and in such position as to allow the Building Official conveniently to make the required entries thereon regarding inspection of the work. This card shall be maintained in such position by the permit holder until the Certificate of Occupancy has been issued.

(c) **Approvals Required.** No work shall be done on any part of the building or structure beyond the point indicated in each successive inspection without first obtaining the written approval of the Building Official. Such written approval shall be given only after an inspection shall have been made of each successive step in the construction as indicated by each of the inspections required in Subsection (d).

There shall be a final inspection and approval on all buildings when completed and ready for occupancy.

(d) **Called Inspections.** No reinforcing steel or structural framework of any part of any building or structure shall be covered or concealed in any manner whatever without first obtaining the approval of the Building Official.

Inspections (Cont'd.)

The Building Official upon notification from the permit holder or his agent shall make the following inspections of Type V buildings and shall either approve that portion of the construction as completed or shall notify the permit holder or his agent wherein the same fails to comply with the law.

1. FOUNDATION INSPECTION: To be made after trenches are excavated and forms erected and when all materials for the foundation are delivered on the job. Where concrete from a central mixing plant (commonly termed "transit mixed") is to be used, materials need not be on the job.
2. FRAME INSPECTION: To be made after the roof, all framing, fire-blocking and bracing are in place and all pipes, chimneys and vents are complete.
3. LATH INSPECTION: To be made after all lathing, interior and exterior, is in place and all plastering materials are delivered on the job, but before any plaster is applied.
4. FINAL INSPECTION: To be made after building is completed and ready for occupancy.

(e) **Other Inspections.** In addition to the called inspections specified above, the Building Official may make any other inspections of any construction work to ascertain compliance with the provisions of this Code and other laws which are enforced by the Building Department.

Special Supervision

Sec. 305. (a) **General.** In addition to the inspections to be made as specified in Section 304, the owner or his agent shall employ a special inspector who shall be present at all times during construction on the following types of work:

1. CONCRETE: On concrete work when the design is based on an f'_c in excess of 2000 pounds.
2. MASONRY: On reinforced masonry work when the design is based on a strength of masonry (f'_m) in excess of 1000 pounds per square inch. On all other types of masonry work when the design is based on unit stresses in excess of 50 per cent of those allowed in Chapter 24.
3. WELDING: On all structural welding.
4. REINFORCED GYPSUM: When cast-in-place reinforced gypsum is being mixed or deposited.
5. SPECIAL CASES: On special construction or work involving unusual hazards or requiring constant inspection.

EXCEPTION: The Building Official may waive the requirement for the employment of a special inspector if he finds that the construction or work is such that no unusual hazard exists.

(b) **Special Inspector.** The special inspector shall be a qualified person approved by the Building Official.

The special inspector shall furnish continuous inspection on the construction and work requiring his employment. He shall report to the Building Official in writing, noting all Code violations and other information as required.

Certificate of Occupancy

Sec. 306. (a) Use or Occupancy. No new building or structure in Groups A to H, inclusive, shall be used or occupied, and no change in the existing occupancy classification of a building or structure or portion thereof shall be made until the Building Official has issued a Certificate of Occupancy therefor as provided herein.

(b) **Change in Use.** Changes in the character or use of a building shall not be made except as specified in Section 502 of this Code.

(c) **Certificate Issued.** After final inspection when it is found that the building or structure complies with the provisions of this Code, and a request has been made by the permittee or owner, the Building Official shall issue a Certificate of Occupancy which shall contain the following:

1. The use and occupancy for which the certificate is issued.
2. A statement that the floor load signs, required by Section 2308, have been installed.
3. A statement that the Room Capacity signs, as required by Section 3301 (i), have been installed.
4. A certification that the building or structure complies with the provisions of this Code.

(d) **Temporary Certificate.** A temporary Certificate of Occupancy may be issued by the Building Official for the use of a portion or portions of a building or structure prior to the completion of the entire building or structure.

(e) **Posting.** The Certificate of Occupancy shall be posted in a conspicuous place on the premises and shall not be removed except by the Building Official.

PART II

DEFINITIONS AND ABBREVIATIONS

CHAPTER 4—DEFINITIONS AND ABBREVIATIONS

Definitions and Abbreviations

Sec. 401. General. For the purpose of this Code, certain abbreviations, terms, phrases, words and their derivatives shall be construed as specified in this Section. Words used in the singular include the plural and the plural the singular. Words used in the masculine gender include the feminine, and the feminine the masculine.

A

Sec. 402. AGRICULTURAL BUILDING is a building located on agricultural property and used to shelter farm implements, hay, grain, poultry, livestock, or other farm produce, in which there is no human habitation, and which is not used by the public.

ALLEY is any public space, public park or thoroughfare less than sixteen feet (16′) but not less than ten feet (10′) in width which has been dedicated or deeded to the public for public use.

ALTER or **ALTERATION** is any change, addition or modification in construction or occupancy.

APARTMENT is a room or suite of rooms which is occupied or which is intended or designed to be occupied by one family for living and sleeping purposes.

APARTMENT HOUSE is any building, or portion thereof, which is designed, built, rented, leased, let or hired out to be occupied, or which is occupied as the home or residence of three or more families living independently of each other and doing their own cooking in the said building, and shall include flats and apartments.

APPROVED as to materials and types of construction, refers to approval by the Building Official as the result of investigation and tests conducted by him, or by reason of accepted principles or tests by national authorities, technical or scientific organizations.

APPROVED AGENCY is an established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved by the Building Official.

AREA (see "Floor Area").

ASSEMBLY BUILDING is a building used, in whole or in part, for the gathering together of persons for such purposes as deliberation, worship, entertainment, amusement, or awaiting transportation.

ATTIC STORY is any story situated wholly or partly in the roof, so designated, arranged or built as to be used for business, storage or habitation.

Definitions (Cont'd.)

Sec. 403. **BALCONY** is that portion of the seating space of an assembly room, the lowest part of which is raised four feet (4') or more above the level of the main floor.

B

BASEMENT is that portion of a building between floor and ceiling, which is partly below and partly above grade (as defined in this Section), but so located that the vertical distance from grade to the floor below is less than the vertical distance from grade to ceiling. (See "Story".)

BAY WINDOW is a rectangular, curved or polygonal window, supported on a foundation extending beyond the main wall of the building.

BUILDING is any structure built for the support, shelter or enclosure of persons, animals, chattels, or property of any kind.

BUILDING, EXISTING, is a building erected prior to the adoption of this Code, or one for which a legal building permit has been issued.

BUILDING OFFICIAL is the officer charged with the administration and enforcement of this Code, or his regularly authorized deputy.

C

Sec. 404. **CAST STONE** is a building stone manufactured from cement concrete precast and used as a trim, veneer or facing on or in buildings or structures.

CELLAR is that portion of a building between floor and ceiling which is wholly or partly below grade (as defined in this Section) and so located that the vertical distance from grade to the floor below is equal to or greater than the vertical distance from grade to ceiling. (See "Story".)

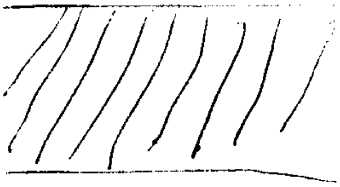
CHIEF OF THE FIRE DEPARTMENT is the head of the Fire Department or his regularly authorized deputy.

COURT is an open, unoccupied space, bounded on two or more sides by the walls of the building. An inner court is a court entirely within the exterior walls of a building. All other courts are outer courts.

D

Sec. 405. **DEAD LOAD** in a building is the weight of the walls, permanent partitions, framing, floors, roofs and all other permanent stationary construction entering into and becoming a part of the building.

DWELLING is any building or any portion thereof, which is not an "Apartment House" or a "Hotel" as defined in this Code, which contains one or more "Apartments" or "Guest Rooms", used, intended, or designed to be built, used, rented, leased, let or hired out to be occupied, or which are occupied for living purposes.



E

Sec. 406. **EXISTING BUILDING**—(See "Building—Existing").

EXIT is a continuous and unobstructed means of egress to a public way, and shall include intervening doorways, corridors, ramps, stairways, smokeproof enclosures, horizontal exits, exterior courts, and yards.

F

Sec. 407. **FAMILY** is one person living alone or a group of two or more persons living together, whether related to each other by birth or not.

Definitions (Cont'd.)

FIRE RESISTANCE or **FIRE-RESISTIVE CONSTRUCTION** is construction to resist the spread of fire, details of which are specified in Chapters 42 and 43 of this Code.

FLOOR AREA is the area included within surrounding walls of a building (or portion thereof), exclusive of vent shafts and courts.

FOOTING is that portion of the foundation of a structure which spreads and transmits loads directly to the soil or the piles.

FRONT OF LOT is the front boundary line of a lot bordering on the street, and in the case of a corner lot may be either frontage.

G

Sec. 408. **GARAGE** is a building or portion thereof in which a motor vehicle containing gasoline, distillate or other volatile, flammable liquid in its tank, is stored, repaired or kept.

GARAGE, PRIVATE, is a building, or a portion of a building, not more than one thousand square feet (1000 sq. ft.) in area, in which only motor vehicles used by the tenants of the building or buildings on the premises are stored or kept. (See Section 1501.)

GARAGE, PUBLIC, is any garage other than a private garage.

GRADE (Ground Level) is the average of the finished ground level at the center of all walls of a building. In case walls are parallel to and within five feet (5') of a sidewalk, the above ground level shall be measured at the sidewalk.

GRADE (Lumber) is the division of sawn lumber into quality classes with respect to its physical and mechanical properties.

GUEST is any person hiring or occupying a room for living or sleeping purposes.

H

Sec. 409. **HEIGHT OF BUILDING** is the vertical distance from the "Grade" to the highest point of the coping of a flat roof or to the deck line of a mansard roof or to the average height of the highest gable of a pitch or hip roof.

HOTEL is any building containing six or more rooms intended or designed to be used, or which are used, rented or hired out to be occupied, or which are occupied for sleeping purposes by guests.

I

Sec. 410. **INCOMBUSTIBLE MATERIAL** is any material which will not ignite at or below a temperature of 1200 degrees Fahrenheit during an exposure of five minutes and which will not continue to burn or glow at that temperature. Tests shall be made as specified in U. B. C. Standard No. 4-1.

J

Sec. 411. No definitions.

K

Sec. 412. No definitions.

L

Sec. 413. **LINTEL** is the beam or girder placed over an opening in a wall, which supports the wall construction above.

LIVE LOADS are all loads except dead and lateral loads.

Definitions (Cont'd.)

Sec. 414. MARQUEE is a permanent roofed structure attached to and supported by the building and projecting over public property. Marquees are regulated in Chapter 45.

M

MASONRY is that form of construction composed of stone, brick, concrete, gypsum, hollow clay tile, concrete block or tile, or other similar building units or materials or a combination of these materials laid up unit by unit and set in mortar.

MASONRY, SOLID, is masonry of solid units built without hollow spaces.

MEZZANINE or **MEZZANINE FLOOR** is an intermediate floor placed in any story or room. When the total area of any such "Mezzanine Floor" exceeds 33⅓ per cent of the total floor area in that room, it shall be considered as constituting an additional "Story". The clear height above or below a "Mezzanine Floor" construction shall be not less than seven feet (7′).

N

Sec. 415. No definitions.

O

Sec. 416. OCCUPANCY is the purpose for which a building is used or intended to be used. The term shall also include the building or room housing such use. Change of occupancy is not intended to include change of tenants or proprietors.

ORIEL WINDOW is a window which projects from the main line of an enclosing wall of a building and is carried on brackets or corbels.

P

Sec. 417. PERSON is a natural person, his heirs, executors, administrators or assigns, and also includes a firm, partnership or corporation, its or their successors or assigns, or the agent of any of the aforesaid.

PLATFORM, ENCLOSED, is a partially enclosed portion of an assembly room the ceiling of which is not more than five feet (5′) above the proscenium opening and which is designed or used for the presentation of plays, demonstrations, or other entertainment wherein scenery, drops, decorations, or other effects are to be installed or used.

Q

Sec. 418. No definitions.

R

Sec. 419. REPAIR is the reconstruction or renewal of any part of an existing building for the purpose of its maintenance. The word "Repair" or "Repairs" shall not apply to any change of construction.

S

Sec. 420. SHAFT is a vertical opening through a building for elevators, dumb-waiter, light, ventilation or similar purposes.

SHALL as used in this Code, is mandatory.

STAGE is a partially enclosed portion of an assembly building which is designed or used for the presentation of plays, demonstrations, or other entertainment wherein scenery, drops, or other effects may be installed or used, and where the distance between the top of the proscenium opening and the ceiling above the stage is more than five feet (5′).

Definitions (Cont'd.)

STAIRWAY. Two or more risers shall constitute a stairway.

STORY is that portion of a building included between the upper surface of any floor and the upper surface of the floor next above, except that the topmost story shall be that portion of a building included between the upper surface of the topmost floor and the ceiling or roof above. If the finished floor level directly above a basement or cellar is more than six feet (6') above grade such basement or cellar shall be considered a story.

STREET is any thoroughfare or public park not less than sixteen feet (16') in width which has been dedicated or deeded to the public for public use.

STRUCTURE is that which is built or constructed, an edifice or building of any kind, or any piece of work artificially built up or composed of parts joined together in some definite manner.

T

Sec. 421. No definitions.

U

Sec. 422. **U.B.C. STANDARDS** is the 1952 Edition of the "Uniform Building Code Standards," also known as "Volume III" of the Uniform Building Code. See Chapter 60.

V

Sec. 423. **VALUE** or **VALUATION** of a building shall be the estimated cost to replace the building in kind, based on current replacement costs, as determined in Section 202 (a).

VENEER is a facing of brick, stone, concrete, tile, metal or similar material attached to a wall for the purpose of providing ornamentation, protection or insulation but not counted as adding strength to the wall.

W

Sec. 424. **WALLS** shall be defined as follows:

Bearing Wall is a wall which supports any load other than its own weight.

Faced Wall is a wall in which the masonry facing and backing are so bonded as to exert a common action under load.

Non-Bearing Wall is a wall which supports no load other than its own weight.

Parapet Wall is that part of any wall entirely above the roof line.

Retaining Wall is any wall used to resist the lateral displacement of any material.

WINDOW. (See "Bay Window"; see "Oriel Window.")

X

Sec. 425. No definitions.

Y

Sec. 426. **YARD** is an open, unoccupied space, other than a court, unobstructed from the ground to the sky, except where specifically provided by this Code, on the lot on which a building is situated.

PART III

REQUIREMENTS BASED ON OCCUPANCY

CHAPTER 5—CLASSIFICATION OF ALL BUILDINGS BY USE OR OCCUPANCY AND GENERAL REQUIREMENTS FOR ALL OCCUPANCIES

Occupancy Classified

Sec. 501. Every building, whether existing or hereafter erected, shall be classified by the Building Official according to its use or the character of its occupancy, as a building of Group A, B, C, D, E, F, G, H, I or J, as defined in Chapters 6, 7, 8, 9, 10, 11, 12, 13, 14 and 15 respectively. (See Table No. 5-A.)

Any occupancy not mentioned specifically or about which there is any question shall be classified by the Building Official and included in the Group which its use most nearly resembles based on the existing or proposed life and fire hazard.

Change in Use

Sec. 502. No change shall be made in the character of occupancy or use of any building which would place the building in a different Group of occupancy, unless such building is made to comply with the requirements of this Code for that Group.

EXCEPTION: The character of the occupancy of existing buildings may be changed subject to the approval of the Building Official, and the building may be occupied for purposes in other Groups without conforming to all the requirements of this Code for those Groups, provided the new or proposed use is less hazardous, based on life and fire risk, than the existing use.

No change in the character of occupancy of a building shall be made without a Certificate of Occupancy, as required in Section 306 of this Code.

Mixed Occupancy

Sec. 503. (a) **General.** When a building is used for more than one occupancy purpose each part of the building comprising a distinct "Occupancy," as described in Chapters 5 to 15, shall be separated from any other occupancy as specified in Section 503 (d).

When a building is used for more than one occupancy purpose, it shall be subject to the most restrictive requirements for the occupancies concerned.

EXCEPTIONS: 1. When a one-story building houses more than one occupancy, each portion of the building shall conform to the requirements for the occupancy housed therein. The maximum floor area of any separate occupancy shall be the area allowed by Section 505, multiplied by the percentage of the building occupied by such occupancy.

2. Where minor accessory uses do not occupy more than 10 per cent of the area of any floor of a building, the major use of the building shall determine the occu-

TABLE NO. 5-A—WALL AND OPENING PROTECTION BASED ON OCCUPANCY*

(See also pages 37 and 38)

Group	OCCUPANCY	Division	FIRE RESISTANCE OF EXTERIOR WALLS		PROTECTION OF OPENINGS IN EXTERIOR WALLS	
			Time Period (Hours)	Distance to Property Line	Opening Protection	Distance to Property Line
A	Any assembly building with a stage and an occupant load of 1000 or more in the building		4	Any Location	No Openings	Less than 5′
B	1—Any assembly building with a stage and an occupant load of less than 1000 in the building.	1-2	4	Less than 5′	No Openings	Less than 5′
	2—Any assembly building without a stage and having an occupant load of 300 or more in the building.		2	5′ to 10′	E or F	5′ to 10′
	3—Any assembly building without a stage and having an occupant load of less than 300 in the building, including such buildings used for school purposes less than four hours per week	3	2	Less than 5′	No Openings	Less than 5′
			1	5′ to 10′	E or F	5′ to 10′
	4—Stadiums, reviewing stands, and amusement park structures not included within Group A nor Divisions 1, 2 and 3, Group B, occupancies.	4	1	Less than 10′	E or F	Less than 10′
C	Any building used for school purposes more than four hours per week, involving assemblage for instruction, education, or recreation, and not classed in Group A or Divisions 1 and 2, Group B, occupancies		4	Less than 5′	No Openings	Less than 5′
			2	5′ to 10′	E or F	5′ to 10′

* For additional restrictions see Chapters under Occupancy, Fire Zones and Types of Construction.

** Or may be protected on the exterior with materials approved for one-hour fire-resistive construction.

TABLE NO. 5-A—WALL AND OPENING PROTECTION BASED ON OCCUPANCY*

(Continued)

Group	OCCUPANCY	Division	FIRE RESISTANCE OF EXTERIOR WALLS		PROTECTION OF OPENINGS IN EXTERIOR WALLS	
			Time Period (Hours)	Distance to Property Line	Opening Protection	Distance to Property Line
D	1—Mental hospitals, jails, prisons, reformatories, houses of correction, and buildings where personal liberties of inmates are similarly restrained	1	4	Any Location	No Openings	Less than 5′
	2—Nurseries for full time care of children under kindergarten age. Hospitals, sanitariums, mental sanitariums conforming to Sec. 3319 (g), and similar buildings (each accommodating more than six persons)	2	4	Less than 5′	No Openings	Less than 5′
			1	5′ or more	E or F	5′ to 10′
	3—Homes for the aged and homes for children of kindergarten age or older, (each accommodating more than six persons.)	3	1	Any Location	No Openings	Less than 3′
					E or F	3′ to 10′
B	1—Storage and handling of hazardous and highly flammable or explosive materials other than flammable liquids	1-2	4	Less than 5′	No Openings	Less than 5′
	2—Storage and handling of Class I, II and III flammable liquids, as specified in U.B.C. Standard 9-1; dry cleaning plants using flammable liquids, paint stores with bulk handling; paint shops and spray painting rooms and shops		2	5′ to 10′	E or F	5′ to 20′
	3—Woodworking establishments, planing mills and box factories; shops, factories where loose, combustible fibres or dust is manufactured, processed or generated; warehouses where highly combustible material is stored	3-4	1	10′ to 20′	E or F	10′ to 20′
	4—Repair garages	5	1	Less than 60′	No Openings	Less than 5′
	5—Aircraft repair hangars				E or F	5′ to 60′

* For additional restrictions see Chapters under Occupancy, Fire Zones and Types of Construction.

** Or may be protected on the exterior with materials approved for one-hour fire-resistive construction.

TABLE NO. 5-A—WALL AND OPENING PROTECTION BASED ON OCCUPANCY*

(Continued)

Group	OCCUPANCY	Division	FIRE RESISTANCE OF EXTERIOR WALLS		PROTECTION OF OPENINGS IN EXTERIOR WALLS	
			Time Period (Hours)	Distance to Property Line	Opening Protection	Distance to Property Line
F	1—Gasoline filling and service stations, storage garages where no repair work is done except exchange of parts and maintenance requiring no open flame, welding, or the use of highly flammable liquids 2—Wholesale and retail stores, office buildings, restaurants, undertaking parlors, printing plants, municipal police and fire stations, factories and workshops using materials not highly flammable or combustible, storage and sales rooms for combustible goods, paint stores without bulk handling.	1-2	1	Less than 10′	No Openings E or F	Less than 5′ 5′ to 10′
	3—Aircraft hangars where no repair work is done except exchange of parts and maintenance requiring no open flame, welding, or the use of highly flammable liquids	3	1	Less than 20′	E or F	Less than 20′
G	Ice plants, power plants, pumping plants, cold storage, and creameries. Factories and workshops using incombustible and non-explosive materials. Storage and sales rooms of incombustible and non-explosive materials.		1	Less than 3′	No Openings	Less than 3′
H	Hotels, apartment houses, dormitories, lodging houses. Convents, monasteries (each accommodating more than 10 persons).		1	Less than 3′	No Openings E or F	Less than 3′ 3′ to 5′
I	Dwellings		1	Less than 3′	No Openings	Less than 3′
J	1—Private garages, sheds and minor buildings used as accessories only when not over one thousand square feet (1000 sq. ft.) in area	1	**1	Less than 3′	No Openings	Less than 3′
	2—Fences over six feet (6′) high, tanks and towers	—	—	—	—	—

* For additional restrictions see Chapters under Occupancy, Fire Zones and Types of Construction.

** Or may be protected on the exterior with materials approved for one-hour fire-resistive construction.

TABLE NO. 5-B—REQUIRED SEPARATIONS IN BUILDINGS OF MIXED OCCUPANCY

(In Hours)

GROUP	A	B	C	D	E-1	E-2	E-3	E-4-5	F-1	F-2	F-3	G	H	I	J
A	N	N	N	3	4	4	4	4	4	3	3	3	1	1	1
B		N	N	3	4	4	4	4	3	1	1	1	1	1	1
C			N	1	4	4	4	4	4	1	1	1	1	1	1
D				N	4	4	4	4	4	4	4	4	1	1	3
E-1					N	1	1	1	2	2	2	2	4	4	1
E-2						N	1	1	1	1	1	1	3	3	1
E-3							N	1	1	1	1	1	3	3	1
E-4-5								N	1	1	1	1	3	3	1
F-1									N	1	1	1	3	1	1
F-2										N	1	1	1	N	1
F-3											N	1	1	N	1
G												N	1	N	N
H													N	N	1
I														N	1*
J															N

*Provided that materials as approved for one-hour fire-resistive construction on the garage side and a self-closing, tight-fitting solid wood door one and three-eighths inches (1⅜") in thickness, shall be permitted.

Mixed Occupancy (Cont'd.)

pancy classification provided the uses are separated as specified in Section 503 (d).

(b) **Forms of Occupancy Separations.** Occupancy separations shall be vertical or horizontal or both or, when necessary, of such other form as may be required to afford a complete separation between the various occupancy divisions in the building.

(c) **Types of Occupancy Separation.** Occupancy separations shall be classed as "Four-Hour Fire-Resistive," "Three-Hour Fire-Resistive," "Two-Hour Fire-Resistive," and "One-Hour Fire-Resistive."

1. A "Four-Hour Fire-Resistive Occupancy Separation" shall have no openings therein and shall be of not less than four-hour fire-resistive construction.

2. A "Three-Hour Fire-Resistive Occupancy Separation" shall be of not less than three-hour fire-resistive construction. All openings in walls forming such separation shall be protected on each side thereof by Class "A" fire doors and such doors shall be kept normally closed. The total width of all openings in any "Three-Hour Fire-Resistive Occupancy Separation" wall in any one story shall not exceed 25 per cent of the length of the wall in that story and no single opening shall have an area greater than one hundred and twenty square feet (120 sq. ft.).

All openings in floors forming a "Three-Hour Fire-Resistive Occupancy Separation" shall be protected by vertical enclosures, extending above and below such openings. The walls of such vertical enclosures shall be of not less than two-hour fire-resistive construction and all openings therein shall be protected on one side thereof by Class "B" fire doors, and such doors shall be kept normally closed.

3. A "Two-Hour Fire-Resistive Occupancy Separation" shall be of not less than two-hour fire-resistive construction. All openings in such separations shall be protected on one side by Class "B" fire doors, and such doors shall be kept normally closed.

4. A "One-Hour Fire-Resistive Occupancy Separation shall be of not less than one-hour fire-resistive construction. All openings in such separations shall be protected with Class "C" fire doors, and such doors shall be kept normally closed.

(d) **Fire Ratings for Occupancy Separations.** Occupancy separations shall be provided between the various groups and divisions of occupancies as set forth in Table No. 5-B. Where any occupancy separation is required the minimum shall be a "One-Hour Fire-Resistive Occupancy Separation."

Location on Property

Sec. 504. (a) **General.** Buildings shall adjoin a public space, yard or street on not less than one side. Required yards shall be permanently maintained.

For the purpose of this Section, the center line of an adjoining street or alley shall be considered an adjacent property line.

(b) **Fire Resistance of Walls.** Exterior walls shall have the degree of fire-resistance and exterior openings shall have the protection as set forth in Table No. 5-A.

(c) **Buildings on Same Property.** For the purpose of de-

termining the required exterior wall protection, buildings on the same property shall be assumed to have a property line between them. **Location on Property (Cont'd.)**

When a new building is to be erected on the same property with an existing building, the assumed property line from the existing building shall be the distance to the property line for each occupancy as set forth in Table No. 5-A. White is 3' to line 70'le between said Buildings 6'

EXCEPTION: Two or more buildings on the same property may be considered as portions of one building if the area within a line circumscribing the buildings is within the limits specified in Section 505. In this case, the space between buildings shall be considered an inner court for the purpose of determining the exterior wall construction.

When the buildings so considered house different occupancies or are of different types of construction, the area shall be that allowed for the most restricted occupancy or construction.

Sec. 505 (a) **One-Story Areas.** The area of a one-story building shall not exceed the limits set forth in Table No. 5-C except as provided in Section 506, nor the limits specified in Chapter 16. **Allowable Floor Areas**

(b) **Areas of Buildings Over One Story.** The total area of all floors of buildings over one story in height shall not exceed 200 per cent of the area allowed for one-story buildings. No single floor area shall exceed that permitted for one-story buildings. Basements and cellars need not be included in the total allowable areas.

For buildings located in Fire Zones 1 and 2 the basic area shall be reduced 25 per cent.

(c) **Separation of Areas.** For the purpose of this section, each portion of a building separated by one or more continuous fire-resistive walls extending from the foundation to the roof at all points may be considered a separate building. Such area separation wall shall be not less than four-hour fire-resistive in buildings of Types I, II and III construction with openings protected as required for Class "A" openings and shall be not less than two-hour fire-resistive in buildings of Types IV and V construction with openings protected as required for Class "D" openings. The total width of all openings in such fire-resistive wall, in each story, shall not exceed 25 per cent of the length of the wall in that story.

See Chapters 6 to 16 inclusive for special occupancy provisions.

Sec. 506 (a). **General.** The increases of floor areas permitted in this Section may be compounded when applicable, except that such increases for approved automatic fire-extinguishing systems shall not apply when other provisions of this Code require such fire-extinguishing installation. **Allowable Area Increases**

(b) **Separation on Two Sides.** Where public space, streets, or yards, more than twenty feet (20') in width, extend along two sides of a building, the areas specified in Section 505 may be increased at a rate of 1¼ per cent for each foot by which the minimum width exceeds twenty feet (20'), but the increase shall not exceed 50 per cent.

TABLE NO. 5-C—BASIC ALLOWABLE FLOOR AREA FOR BUILDINGS ONE STORY IN HEIGHT*

(In Square Feet)

Occupancy	TYPES OF CONSTRUCTION							
	I	II	III		IV		V	
			1-Hour or H.T.	N	1-Hour	N	1-Hour	N
A	Unlimited	Not Permitted						
B) 1-2	Unlimited	18,000	13,500	Not Permitted	13,500	Not Permitted	10,500	Not Permitted
B) 3-4	Unlimited	18,000	13,500	9,000	13,500	9,000	10,500	6,000
C	Unlimited	27,000	20,250	13,500	20,250	13,500	15,750	9,000
D) 1	Unlimited	Not Permitted						
D) 2-3	Unlimited	9,000	6,750	Not Permitted	6,750	Not Permitted	5,250	Not Permitted
E) 1-2	15,000	7,500	5,625	3,750	5,625	3,750	4,375	2,500
E) 3-4-5	Unlimited	15,000	11,250	7,500	11,250	7,500	8,750	5,000
F) 1-2-3	Unlimited	24,000	18,000	12,000	18,000	12,000	14,000	8,000
G	Unlimited	36,000	27,000	18,000	27,000	18,000	21,000	12,000
H	Unlimited	18,000	13,500	9,000 Sec. 1302 (b)	13,500	9,000 Sec. 1302 (b)	10,500	6,000 Sec. 1302 (b)
I	Unlimited							
J	See Chapter 15							

N. No general requirements for fire resistance.
H. T. Heavy Timber.
*For buildings located in Fire Zones 1 and 2, the basic area shall be reduced 25 per cent.

TABLE NO. 5-D—MAXIMUM HEIGHT OF BUILDINGS

OCCUPANCY	TYPES OF CONSTRUCTION							
	I	II	III		IV		V	
			1-Hr.orH.T.	N	1-Hour	N	1-Hour	N
	MAXIMUM HEIGHT IN FEET							
	Unlimited	95′	65′	55′	65′	55′	50′	40′
	MAXIMUM HEIGHT IN STORIES							
A	Unlimited	Not Permitted						
B) 1-2	Unlimited	4	2	Not Permitted	2	Not Permitted	2	Not Permitted
B) 3-4	Unlimited	4	2	1	2	1	2	1
C	Unlimited	4 Sec. 802 (b)	2 Sec. 802 (b)	1	2 Sec. 802 (b)	1	2 Sec. 802 (b)	1
D) 1	Unlimited	Not Permitted						
D) 2	Unlimited	3	1	Not Permitted	1	Not Permitted	1	Not Permitted
D) 3	Unlimited	3	2	Not Permitted	2	Not Permitted	2	Not Permitted
E) 1	Unlimited	2	1	1	1	1	1	1
E) 2-3-4-5	Unlimited	2	2	1	2	1	2	1
F) 1-2-3	Unlimited	6	4	2	4	2	3	2
G	Unlimited	6	4	2	4	2	3	2
H	Unlimited	5	4	2	4	2	3	2
I	Unlimited	3	3	3	3	3	3	3
J	See Chapter 15							

N. No general requirements for fire resistance.
H. T. Heavy Timber

Allowable Area Increases (Cont'd.)

(c) **Separation on Three Sides.** Where public space, streets, or yards, more than twenty feet (20′) in width, extend along three sides of a building, the areas specified in Section 505 may be increased at a rate of 2½ per cent for each foot by which the minimum width exceeds twenty feet (20′), but the increase shall not exceed 100 per cent.

(d) **Separation on All Sides.** Where public space, streets, or yards, more than twenty feet (20′) in width, extend on all sides of one and two-story buildings and adjoin the entire perimeter, the areas specified in Section 505 may be increased at a rate of five per cent for each foot by which the minimum width exceeds twenty feet (20′). Such increases shall not exceed 100 per cent, except for buildings not exceeding two stories in height of Group G occupancy and one-story buildings housing aircraft storage hangars and as further limited in Section 1002(b) for aircraft repair hangars.

(e) **Unlimited Area.** The area of any one or two-story building of Division 5, Group E, Group F and G occupancy shall not be limited, if the building is provided with an approved fire-extinguishing system throughout, as specified in Chapter 38, and entirely surrounded by public space, streets, or yards not less than sixty feet (60′) in width.

The area of a one-story Type II or Type IV building of Group G occupancy shall not be limited if the building is entirely surrounded by public space, streets or yards not less than sixty feet (60′) in width.

(f) **Sprinklers.** The areas specified in Section 505 may be tripled in one-story buildings and doubled in buildings of more than one-story if the building is provided with an automatic fire-extinguishing system throughout as specified in Chapter 38.

Maximum Height of Buildings and Increases

Sec. 507. The maximum height and number of stories of every building shall be dependent upon the character of the occupancy and the type of construction, and shall not exceed the limits set forth in Table No. 5-D, except as provided in this Section. The height shall be measured from the highest adjoining sidewalk or ground surface, provided that the height measured from the lowest adjoining surface shall not exceed such maximum height more than ten feet (10′).

The limits set forth in Table No. 5-D may be increased by one story if the building is provided with an automatic fire-extinguishing system throughout installed in accordance with the provisions of Chapter 38. The increase in height for sprinklers shall not apply when other provisions of this Code require automatic fire-extinguishing systems throughout or when the increases under Section 506 (f) are used.

EXCEPTION: 1. Towers, spires, and steeples erected as a part of a building and not used for habitation or storage may extend not to exceed twenty feet (20′) above such height limit.

2. The height of one-story aircraft hangars shall not be limited if the building is provided with automatic fire-extinguishing systems throughout as specified in Chapter 38 and is entirely surrounded by public space, streets, or

yards not less in width than 150 per cent of the height of the building. **Heights Maximum (Cont'd.)**

See Chapters 6 to 16 inclusive for special occupancy provisions.

Sec. 508. One-Hour Fire-Resistive Substitution. Where one-hour fire-resistive construction throughout is required by this Code, an approved fire-extinguishing system, as specified in Chapter 38, may be substituted, provided such system is not otherwise required. **Fire-Resistive Substitution**

Sec. 509. Arcades. Arcades connecting buildings and used exclusively as passageways need not be considered as adjacent buildings for the provisions of this Chapter, provided that the walls of the building adjoining the arcades are finished with the same construction as required for the exterior walls of the building, with no communicating openings between the arcades and the building, except doors; and provided that the arcades are of not less than one-hour fire-resistive construction or entirely of incombustible materials, or of heavy timber construction with two-inch (2") nominal sheathing. **Arcades**

CHAPTER 6 — REQUIREMENTS FOR GROUP A OCCUPANCIES

Group A Occupancies Defined

Sec. 601. Group A Occupancies shall be:

Any assembly building with a stage and an occupant load of 1000 or more in the building.

For occupancy separations see Table No. 5-B.

For occupant load see Section 3301.

Construction, Height and Area Allowable

Sec. 602. (a) **General.** Buildings or parts of buildings classed in Group A because of the use or character of the occupancy shall be of Type I Construction and shall not be limited as to location in fire zones, occupant load, height or area.

(b) **Special Provisions.** Stages and enclosed platforms as defined in Section 401 shall be constructed in accordance with Chapter 39.

The slope of the main floor of the assembly room shall not exceed one in five.

Location on Property

Sec. 603. Buildings housing Group A occupancies shall front directly upon at least one public street not less than twenty feet (20′) in width, in which front shall be located the main entrance and exit of such building. The main assembly floor shall be located at or near the adjacent ground level.

For fire-resistive protection of exterior walls and openings, as determined by location on property, see Section 504.

Exit Facilities

Sec. 604. Stairs, exits, and smokeproof enclosures shall be provided as specified in Chapter 33.

Light, Ventilation, and Sanitation

Sec. 605. All portions of Group A occupancies customarily used by human beings and all dressing rooms shall be provided with light and ventilation by means of windows or skylights with an area not less than one-eighth of the total floor area, one-half of which shall be openable, or shall be provided with artificial light and a mechanically operated ventilating system. The mechanically operated ventilating system shall supply a minimum of five cubic feet (5 cu. ft.) per minute of outside air with a total circulated of not less than fifteen cubic feet (15 cu. ft.) per minute per seat in all portions of the building and such system shall be kept continuously in operation during such time as the building is occupied. If the velocity of the air at the register exceeds ten feet (10′) per second, the register shall be placed more than eight feet (8′) above the floor directly beneath.

Lights in all parts of the building customarily used by human beings shall be on a separate circuit from that of the stage and shall be controlled from the box office. All lights in corridors, exit courts and exit passageways shall be protected by a wire cage.

All registers or vents supplying air backstage shall be equipped with automatic closing devices with fusible links. Such closing devices shall be located where the vents or ducts pass through the proscenium walls and shall be oper-

ated by fusible links located on both sides of the proscenium wall and both inside of and outside of the vent or duct.

There shall be provided in an approved location at least one lavatory for each two toilets for each sex, and at least one drinking fountain for each floor level.

Enclosure of Vertical Openings

Sec. 606. Exits shall be enclosed as specified in Chapter 33.

Elevator shafts, vent shafts and other vertical openings shall be enclosed and the enclosure shall be as set forth in Table No. 17-A. (See also Chapter 30.)

Fire-Extinguishing Systems

Sec. 607. Automatic fire-extinguishing systems, standpipes and basement pipe inlets shall be installed as specified in Chapter 38.

Special Hazards

Sec. 608. Stages shall be equipped with automatic ventilators as required in Section 3901.

Chimneys and heating apparatus shall conform to the requirements of Chapters 37 and 51.

Motion picture machine booths shall conform to the requirements of Chapter 40.

Flammable liquids shall not be placed or stored in any Group A occupancy.

Every gas service to the stage portion of the building shall be separated from any other service to the building and each building shall be provided with an approved shut-off valve at a convenient and conspicuous place outside the building and adequately marked.

Exterior openings in a boiler room or room containing central heating equipment, if located below openings in another story or if less than ten feet (10') from other doors or windows of the same building, shall be protected by Class "E" or "F" fire doors or windows.

Every boiler room or room containing a heating plant which burns liquid or solid fuel shall be separated from the rest of the building by a "Three-Hour Fire-Resistive Occupancy Separation."

Every boiler room or room containing a heating plant which burns gas as fuel shall be separated from the rest of the building by not less than a "One-Hour Fire-Resistive Occupancy Separation."

Exceptions and Deviations

Sec. 609. Gymnasiums and similar occupancies may have running tracks constructed of wood or unprotected steel or iron.

CHAPTER 7 — REQUIREMENTS FOR GROUP B OCCUPANCIES

Group B Occupancies Defined

Sec. 701. Group B occupancies shall be:

Division 1. Any assembly building with a stage and an occupant load of less than 1000 in the building.

Division 2. Any assembly building without a stage and having an occupant load of 300 or more in the building.

Division 3. Any assembly building without a stage and having an occupant load of less than 300 in the building, including such buildings used for school purposes less than four hours per week.

Division 4. Stadiums, reviewing stands, and amusement park structures not included within Group A nor Divisions 1, 2 and 3, Group B, occupancies.

For occupancy separations see Table No. 5-B.

For occupant load see Section 3301.

Construction, Height and Area Allowable

Sec. 702. (a) **General.** Buildings or parts of buildings classed in Group B because of the use or character of the occupancy shall not exceed, in area or height, the limits specified in Sections 505, 506, and 507.

EXCEPTION: Division 4 structures of open skeleton frame type shall not be limited in area or height.

(b) **Special Provisions.** Stages and enclosed platforms as defined in Section 401 shall be constructed in accordance with Chapter 39.

Divisions 1 and 2 occupancies shall be of not less than one-hour fire-resistive construction throughout, except that a fire-resistive ceiling shall not be required in one-story buildings of Type III, IV, or V construction having an open frame roof. Division 2 occupancies with an occupant load of 1000 or more shall be of Type I, II or III construction.

EXCEPTION: Gymnasiums which have not more than two balconies, each with an occupant load not to exceed 300, and which are not located over usable spaces need not have one-hour fire-resistive protection.

Division 3 occupancies located in a basement or above the first story shall be of not less than one-hour fire-resistive construction.

Group B assembly rooms having an occupant load of 1000 or more shall not be located in the basement.

Division 3 occupancies with an occupant load of 50 or more, which are located over usable space, shall be separated from such space by not less than one-hour fire-resistive construction.

For attic space partitions and draft stops see Section 3206.

(c) **Division 4 Provisions.** Erection and structural maintenance of structures housing Division 4 occupancies shall conform to the requirements of this Code, and where there

are no such specific requirements, shall provide adequate safety for the loads to which they may be subjected.

Structures housing Division 4 occupancies, other than those of open skeleton frame type, when more than one story in height or four hundred square feet (400 sq. ft.) in area, shall be of not less than one-hour fire-resistive construction.

When the space under a Division 4 occupancy is used for any purpose, it shall be separated from all parts of such Division 4 occupancy, including exits, by walls, floors and ceilings of not less than one-hour fire-resistive construction.

The Building Official may cause all Division 4 structures to be re-inspected at least once every six months.

Location on Property

Sec. 703. All buildings housing Group B occupancies shall front directly upon at least one public street, not less than twenty feet (20') in width, in which front shall be located the main entrance of such building.

For fire-resistive protection of exterior walls and openings, as determined by location on property, see Section 504.

Exit Facilities

Sec. 704. (a) **General.** Stairs, exits, and smokeproof enclosures shall be provided as specified in Chapter 33.

(b) **Amusement Structures.** Stairs and exits for Division 4 amusement structures shall be provided as specified in Chapter 33, subject to the approval of the Building Official. Exit signs shall be installed as specified in Section 3312 and where required by the Building Official.

Light, Ventilation, and Sanitation

Sec. 705. All portions of Group B occupancies customarily used by human beings and all dressing rooms shall be provided with natural or artificial light, ventilation, and sanitary facilities as specified in Section 605.

Enclosure of Vertical Openings

Sec. 706. Exits shall be enclosed as specified in Chapter 33.

Elevator shafts, vent shafts, and other vertical openings shall be enclosed, and the enclosure shall be as set forth in Table No. 17-A. (See also Chapter 30.)

Fire-Extinguishing Systems

Sec. 707. Automatic fire-extinguishing systems, standpipes and basement pipe inlets shall be installed as specified in Chapter 38.

Special Hazards

Sec. 708. Chimneys and heating apparatus shall conform to the requirements of Chapters 37 and 51.

Motion picture machine booths shall conform to the requirements of Chapter 40.

Flammable liquids shall not be placed or stored in a Group B occupancy.

Each building shall be provided with an approved outside gas shut-off valve conspicuously marked.

Exterior openings in a boiler room or room containing central heating equipment, if located below openings in another story or if less than ten feet (10') from other doors or windows of the same building, shall be protected by Class "E" or "F" fire doors or windows.

Every boiler room or room containing a heating plant which burns liquid or solid fuel shall be separated from the rest of the building by a "Three-Hour Fire-Resistive Occu-

Special Hazards (Cont'd.)

pancy Separation." Every boiler room or room containing a heating plant which burns gas as fuel shall be separated from the rest of the building by not less than a "One-Hour Fire-Resistive Occupancy Separation."

Exceptions and Deviations

Sec. 709. Gymnasiums and similar occupancies may have running tracks constructed of wood or unprotected steel or iron.

In gymnasiums, one inch (1") nominal tight tongue and grooved wall covering may be used on the gymnasium side in lieu of fire-resistive plaster.

CHAPTER 8 — REQUIREMENTS FOR GROUP C OCCUPANCIES

Group C Occupancies Defined

Sec. 801. Group C occupancies shall be:

Any building used for school purposes more than four hours per week, involving assemblage for instruction, education or recreation, and not classed in Group A occupancies or in Divisions 1 and 2 of Group B occupancies.

For occupancy separations see Table No. 5-B.

For occupant load see Section 3301.

Construction, Height and Area Allowable

Sec. 802. (a) **General.** Buildings or parts of buildings classed in Group C because of the use or character of the occupancy shall not exceed, in area or height, the limits specified in Sections 505, 506, and 507.

(b) **Special Provisions.** Rooms having an occupant load of more than 100 and rooms used for kindergarten, first or second grade pupils shall not be located above the first story above grade except in buildings of Type I construction.

Where there is usable space under the first floor of two-story Type III, IV and V buildings, the construction up to and including the first floor shall be of Type I construction, and the first floor shall be unpierced for human access.

Balconies and bleachers over usable space and all janitor closets shall be protected with materials approved for one-hour fire-resistive construction.

All curtains, drops and drapes shall be flame-proofed.

Stages and enclosed platforms shall be constructed in accordance with Chapter 39.

The provisions of Section 1803 (b) shall not apply to openings in buildings not more than three stories high when such openings are not less than thirty feet (30′) from adjacent property lines and not less than thirty feet (30′) from buildings on the same property.

For attic space partitions and draft stops, see Section 3206.

Location on Property

Sec. 803. (a) **General.** Group C occupancies shall front directly upon at least one public street, not less than twenty feet (20′) in width, in which front shall be located at least one required exit.

For fire-resistive protection of exterior walls and openings, as determined by location on property, see Section 504.

(b) **Special Provision.** Exterior walls or parts of walls of Group C occupancy having an occupant load of less than 100 persons, when within ten feet (10′) of adjacent property lines, may be of one-hour fire-resistive construction.

Exit Facilities

Sec. 804. Stairs, exits, and smokeproof enclosures shall be provided as specified in Chapter 33.

Light, Ventilation, and Sanitation

Sec. 805. All portions of Group C occupancies shall be provided with light and ventilation, either natural or artificial, as specified in Section 605.

Toilets shall be provided on the basis of the following ratios of toilets to number of students:

	Girls	Boys
Elementary Schools	1:35	1:100
Secondary Schools	1:45	1:100

In addition, urinals shall be provided for boys on a basis of 1:30.

There shall be provided at least one lavatory for each two toilets or urinals for each sex and at least one drinking fountain on each floor.

Enclosure of Vertical Openings

Sec. 806. Exits shall be enclosed as specified in Chapter 33.

Elevator shafts, vent shafts, and other vertical openings shall be enclosed, and the enclosure shall be as set forth in Table No. 17-A. (See also Chapter 30.)

Fire-Extinguishing Systems

Sec. 807. Automatic fire-extinguishing systems, standpipes and basement pipe inlets shall be installed as specified in Chapter 38.

Special Hazards

Sec. 808. Chimneys and heating apparatus shall conform to the requirements of Chapters 37 and 51.

Motion picture machine booths shall conform to the requirements of Chapter 40.

Each building shall be provided with an approved outside gas shut-off valve conspicuously marked.

Exterior openings in a boiler room or room containing central heating equipment, if located below openings in another story or if less than ten feet (10′) from other doors or windows of the same building, shall be protected by Class "E" or "F" fire doors or windows.

Every boiler room or room containing a central heating plant which burns liquid or solid fuel shall be separated from the rest of the building by a "Three-Hour Fire-Resistive Occupancy Separation." Every boiler room or room containing a heating plant which burns gas as fuel shall be separated from the rest of the building by not less than a "One-Hour Fire-Resistive Occupancy Separation."

No flammable liquids shall be placed, stored or used in any Group C occupancies, except in approved quantities as necessary in laboratories and approved utility rooms, and such liquids shall be kept in tight or sealed containers when not in actual use.

Exceptions and Deviations

Sec. 809. Gymnasiums and similar buildings may have running tracks constructed of wood or unprotected steel or iron.

In gymnasiums and in multi-purpose school rooms having an area not greater than thirty-two hundred square feet (3,200 sq. ft.) one-inch (1″) nominal tight tongue and grooved or three-fourths inch (¾″) plywood wall covering may be used on the inner side in lieu of fire-resistive plaster.

Roof covering shall be a "fire-retardant" roofing as specified in Section 3204.

CHAPTER 9 — REQUIREMENTS FOR GROUP D OCCUPANCIES

Group D Occupancies Defined

Sec. 901. Group D occupancies shall be:

Division 1: Mental hospitals, jails, prisons, reformatories, houses of correction, and buildings where personal liberties of inmates are similarly restrained.

Division 2: Nurseries for the full time care of children under kindergarten age, (each accommodating more than six persons).

Hospitals, sanitariums, mental sanitariums conforming to Section 3319 (g), and similar buildings (each accommodating more than six persons).

Division 3. Homes for the aged and homes for children of kindergarten age and older. (each accommodating more than six persons).

For occupancy separations see Table No. 5-B.
For occupant load see Section 3301.

Construction, Height and Area Allowable

Sec. 902. (a) General. Buildings or parts of buildings classed in Group D because of the use or character of the occupancy shall not exceed, in area or height, the limits specified in Sections 505, 506, and 507.

(b) Special Provisions. Division 1 occupancies shall be of Type I construction throughout. Occupancies in which the personal liberties of inmates or patients are restrained within the building shall have floors of incombustible construction.

Division 2 and 3 occupancies shall be one-hour fire-resistive construction throughout and shall be of Type I or II construction if more than two stories in height.

For attic space partitions and draft stops, see Section 3206.

Location on Property

Sec. 903. For fire-resistive protection of exterior walls and openings, as determined by location on property, see Section 504.

Exit Facilities

Sec. 904. Stairs, exits, and smokeproof enclosures shall be provided as specified in Chapter 33.

Light and Ventilation

Sec. 905. All portions of Group D occupancies customarily used by human beings shall be provided with light and ventilation by means of windows or skylights with an area equal to one-eighth of the total floor area, one-half of which shall be openable, or shall be provided with artificial light and a mechanically-operated ventilating system as specified in Section 605.

Enclosure of Vertical Openings

Sec. 906. Exits shall be enclosed as specified in Chapter 33.

Elevator shafts, vent shafts, and other vertical openings shall be enclosed, and the enclosure shall be as set forth in Table No. 17-A. (See also Chapter 30.)

Fire-Extinguishing Systems

Sec. 907. Automatic fire-extinguishing systems, standpipes and basement pipe inlets shall be installed as specified in Chapter 38.

Special Hazards

Sec. 908. Chimneys and heating apparatus shall conform to the requirements of Chapters 37 and 51.

Motion picture machine booths shall conform to the requirements of Chapter 40.

Storage of volatile flammable liquids shall not be allowed in Group D occupancies and the handling of such liquid shall not be permitted in any Group D occupancies in quantities of more than one gallon unless such handling complies with U. B. C. Standard No. 9-1.

Each building shall be provided with an approved outside gas shut-off valve conspicuously marked.

Every boiler room or room containing a heating plant which burns liquid or solid fuel shall be separated from the rest of the building by a "Three-Hour Fire-Resistive Occupancy Separation." Every boiler room or room containing a heating plant which burns gas as fuel shall be separated from the rest of the building by not less than a "One-Hour Fire-Resistive Occupancy Separation."

CHAPTER 10 — REQUIREMENTS FOR GROUP E OCCUPANCIES

Group E Occupancies Defined

Sec. 1001. Group E occupancies shall be:

Division 1. Storage and handling of hazardous and highly flammable or explosive materials other than flammable liquids.

Division 2. Storage and handling of Class I, II and III flammable liquids, as specified in U.B.C. Standard 9-1; dry cleaning plants using flammable liquids, paint stores with bulk handling; paint shops and spray painting rooms and shops.

Division 3. Woodworking establishments, planing mills and box factories; shops, factories where loose, combustible fibres or dust is manufactured, processed or generated; warehouses where highly combustible material is stored.

Division 4. Repair garages.

Division 5. Aircraft repair hangars.

For occupancy separations see Table No. 5-B.

For occupant load see Section 3301.

Note: Highly flammable liquids shall be deemed to be those with a flash point below 190 degrees Fahrenheit as determined by the closed cup tester, provided that liquids with a flash point above 138.5 degrees Fahrenheit shall not be deemed to be highly flammable when used in a closed safety cleaning system meeting the requirements of U. B. C. Standard No. 10-1 for a class III rating.

Construction, Height and Area Allowable

Sec. 1002. (a) **General.** Buildings or parts of buildings classed in Group E because of the use or character of the occupancy shall not exceed, in area or height, the limits specified in Sections 505, 506, and 507.

(b) **Special Provisions.** Division 2 occupancies shall have exterior walls of not less than one-hour fire-resistive construction or shall be surrounded by public space, streets, or yards, not less than sixty feet (60′) in width.

The area increases allowed by Section 506 (d) shall not exceed 500 per cent for aircraft repair hangars.

Floors shall be of incombustible materials or of not less than Type II construction. In public garages and where flammable or explosive liquids are used or stored floors shall be entirely protected with incombustible materials against saturation.

In buildings over ninety-five feet (95′) in height, the structural frame shall be protected with not less than four-hour fire-resistive protection and the floors shall be of not less than three-hour fire-resistive construction.

For attic space partitions and draft stops see Section 3206.

Location on Property

Sec. 1003. For fire-resistive protection of exterior walls and openings, as determined by location on property, see Section 504.

Exit Facilities

Sec. 1004. Stairs, exits, and smokeproof enclosures shall be provided as specified in Chapter 33.

Where ramps are used for the transfer of automobiles from one floor to another such ramps shall meet the ground floor level at a point not less than twenty feet (20′) from the exit from such building.

Light, Ventilation, and Sanitation

Sec. 1005. All portions of Group E occupancies customarily used by human beings shall be provided with light and ventilation by means of windows or skylights with an area equal to one-eighth of the total floor area, one-half of which shall be openable, or shall be provided with artificial light and a mechanically-operated ventilating system as specified in Section 605.

In all buildings used for the storing or handling of automobiles operated under their own power, and in all buildings where flammable liquids are used, exhaust ventilation shall be provided sufficient to produce one complete change of air every 15 minutes. Such exhaust ventilation shall be taken from a point at or near the floor level.

EXCEPTION: In public garages and aircraft hangars not exceeding an area of five thousand square feet (5000 sq. ft.), the Building Official may authorize the omission of such ventilating equipment where, in his opinion, the building is supplied with unobstructed openings to the outer air which are sufficient to provide the necessary ventilation.

Every building or portion thereof where persons are employed shall be provided with at least one toilet. Every building and each subdivision thereof where both sexes are employed shall be provided with access to at least two toilets located either in such building or conveniently in a building adjacent thereto.

Enclosure of Vertical Openings

Sec. 1006. Exits shall be enclosed as specified in Chapter 33.

Elevator shafts, vent shafts, and other vertical openings shall be enclosed, and the enclosure shall be as set forth in Table No. 17-A. (See also Chapter 30.)

Doors which are part of an automobile ramp enclosure may be kept normally open but shall be equipped with fusible links and so arranged as to be self-closing when released.

Fire-Extinguishing Systems

Sec. 1007. Automatic fire-extinguishing systems, standpipes and basement pipe inlets shall be installed as specified in Chapter 38.

Special Hazards

Sec. 1008. Chimneys and heating apparatus shall conform to the requirements of Chapters 37 and 51.

In any room in which volatile flammable liquids are used or stored no device generating a glow or flame capable of igniting gasoline vapor shall be installed or used within twenty-four inches (24″) of the floor.

The use, handling, storage and sale of gasoline, fuel oil and other flammable liquids shall not be permitted in any Group E occupancy unless such use, handling, storage and sale comply with U. B. C. Standard No. 9-1.

Special Hazards (Cont'd.)

Dry cleaning plants in which highly flammable solvents are used or stored shall be of Type I construction and shall not exceed one story in height. All partitions shall be of four-hour fire-resistive construction, except for the necessary openings for the vent ducts, piping and shafting. All openings in exterior walls, except wall vents, shall be protected by Class "E" or "F" fire doors or windows. Wall vents having an area of not less than sixteen square inches (16 sq. in.) each, shall be placed in the exterior walls near the floor line, not more than six feet (6') apart horizontally. Each building shall be provided with a power-driven fan exhaust system of ventilation which shall be arranged and operated so as to produce a complete change of air in each room every three minutes.

Each machine in dry cleaning establishments which uses a volatile flammable liquid shall have an adequate steam line directly connected to it, so arranged as to have the steam automatically released to the inside of such machine should an explosion occur in the machine.

Equipment or machinery which generates or emits combustible or explosive dust or fibres shall be provided with an adequate dust collecting and exhaust system installed in conformance with U.B.C. Standard No. 10-2, unless the building or portion thereof housing such machinery is provided with an automatic fire-extinguishing system conforming to the provisions of Chapter 38. The fire-extinguishing system for such occupancies having a floor area of less than three thousand square feet (3,000 sq. ft.) may be a type conforming to the provisions of Exception 2, Section 3802.

CHAPTER 11 — REQUIREMENTS FOR GROUP F OCCUPANCIES

Group F Occupancies Defined

Sec. 1101. Group F occupancies shall be:

Division 1. Gasoline filling and service stations, storage garages where no repair work is done except exchange of parts and maintenance requiring no open flame, welding, or the use of highly flammable liquids.

Division 2. Wholesale and retail stores, office buildings, restaurants, undertaking parlors, printing plants, municipal police and fire stations, factories and workshops using materials not highly flammable or combustible, storage and sales rooms for combustible goods, paint stores without bulk handling.

Division 3. Aircraft hangars where no repair work is done except exchange of parts and maintenance requiring no open flame, welding, or the use of highly flammable liquids.

For occupancy separations see Table No. 5-B.

For occupant load see Section 3301.

Construction, Height and Area Allowable

Sec. 1102. (a) **General.** Buildings or parts of buildings classed in Group F because of the use or character of the occupancy shall not exceed, in area or height, the limits specified in Sections 505, 506, and 507.

(b) **Special Provisions.** Gasoline filling stations of Type V construction shall have incombustible exterior wall covering. Canopies, including supports thereof, over pumps shall be of incombustible materials or not less than one-hour fire-resistive construction.

Aircraft hangars shall have exterior walls, or parts of walls, within twenty feet (20′) of a property line, or within forty feet (40′) of buildings on the same property, of not less than one-hour fire-resistive construction with all openings protected by Class "E" or "F" fire doors or windows.

Storage areas in excess of one thousand square feet (1,000 sq. ft.), in connection with wholesale or retail sales, shall be separated from the public areas by a one-hour fire-resistive occupancy separation.

For attic space partitions and draft stops see Section 3206.

Location on Property

Sec. 1103. For fire-resistive protection of exterior walls and openings, as determined by location on property, see Section 504.

Exit Facilities

Sec. 1104. Stairs, exits, and smokeproof enclosures shall be provided as specified in Chapter 33.

Light, Ventilation and Sanitation

Sec. 1105. All portions of Group F occupancies customarily used by human beings shall be provided with light and ventilation by means of windows or skylights with an area not less than one-eighth of the total floor area or shall be provided with artificial light and a mechanically operated ventilating system. In no case shall less than two changes of air per hour be provided.

Light Ventilation and Sanitation (Cont'd.)

In all buildings used for the storing or handling of automobiles operated under their own power, and in all buildings where flammable liquids are used, exhaust ventilation shall be provided sufficient to produce one complete change of air every 15 minutes. Such exhaust ventilation shall be taken from a point at or near the floor level.

EXCEPTION: In public garages and aircraft hangars not exceeding an area of five thousand square feet (5000 sq. ft.), the Building Official may authorize the omission of such ventilating equipment where, in his opinion, the building is supplied with unobstructed openings to the outer air which are sufficient to provide the necessary ventilation.

Every building or portion thereof where persons are employed shall be provided with at least one toilet. Every building and each subdivision thereof where both sexes are employed shall be provided with access to at least two toilets located either in such building or conveniently in a building adjacent thereto.

Such toilet rooms in connection with food establishments where food is prepared, stored, or served, shall have a nonabsorbent interior finish on floors, walls, and ceilings, shall be separated from such food establishments with close-fitting, tight doors with a vestibule between, shall have hand washing facilities therein or adjacent thereto. All toilet rooms shall be provided with an exterior window at least three square feet (3 sq. ft.) in area, fully openable, or a vertical duct not less than forty-eight square inches (48 sq. in.) in area, leading to the exterior in the building.

Enclosure of Vertical Openings

Sec. 1106. Exits shall be enclosed as specified in Chapter 33.

Elevator shafts, vent shafts, and other vertical openings shall be enclosed, and the enclosure shall be as set forth in Table No. 17-A. (See also Chapter 30.)

Fire-Extinguishing Systems

Sec. 1107. Automatic fire-extinguishing systems, standpipes and basement pipe inlets shall be installed as specified in Chapter 38.

Special Hazards

Sec. 1108. Chimneys and heating apparatus shall conform to the requirements of Chapters 37 and 51.

No storage of volatile flammable liquids shall be allowed in Group F occupancies and the handling and use of gasoline, fuel oil and other flammable liquids shall not be permitted in any Group F occupancy unless such use and handling comply with U. B. C. Standard No. 9-1.

Devices generating a glow or flame capable of igniting gasoline vapor shall not be installed or used within twenty-four inches (24") of the floor in any room in which volatile flammable liquids are used or stored.

CHAPTER 12 — REQUIREMENTS FOR GROUP G OCCUPANCIES

Group G Occupancies Defined

Sec. 1201. Group G occupancies shall be:

Ice plants, power plants, pumping plants, cold storage, creameries.

Factories and workshops using incombustible and non-explosive materials.

Storage and sales rooms of incombustible and non-explosive materials.

For occupancy separations see Table No. 5-B.

For occupant load see Section 3301.

Construction, Height and Area Allowable

Sec. 1202. (a) **General.** Buildings or parts of buildings classed in Group G because of the use or character of the occupancy shall not exceed, in area or height, the limits specified in Sections 505, 506, and 507.

(b) **Special Provisions.** Fire protection of the under side of roof framing may be omitted in all Types of Construction.

For attic space partitions and draft stops see Section 3206.

Location on Property

Sec. 1203. For fire-resistive protection of exterior walls and openings, as determined by location on property, see Section 504.

Exit Facilities

Sec. 1204. Stairs, exits, and smokeproof enclosures shall be provided as specified in Chapter 33.

Passageways direct to outside exits, free of all incumbrances and at least seven feet (7′) in width, clearly defined by floor markings and overhead signs, shall be maintained permanently.

Light, Ventilation, and Sanitation

Sec. 1205. All portions of Group G occupancies customarily used by human beings shall be provided with light and ventilation as specified in Section 1105.

Every building or portion thereof where persons are employed shall be provided with at least one toilet. Every building and each subdivision thereof where both sexes are employed shall be provided with access to at least two toilets located either in such building or conveniently in a building adjacent thereto.

Enclosure of Vertical Openings

Sec. 1206. Exits shall be enclosed as specified in Chapter 33. Other vertical openings are not required to be enclosed.

Fire-Extinguishing Systems

Sec. 1207. Automatic fire-extinguishing systems, standpipes and basement pipe inlets shall be installed as specified in Chapter 38.

Special Hazards

Sec. 1208. Chimneys and heating apparatus shall conform to the requirements of Chapters 37 and 51.

In any room in which volatile flammable liquids are used or stored, no device generating a glow or flame capable of igniting gasoline vapor shall be installed or used within twenty-four inches (24″) of the floor.

The storage, use and handling of gasoline, fuel oil and other flammable liquids shall not be permitted in any Group G occupancy unless such storage, use, and handling comply with U. B. C. Standard No. 9-1.

CHAPTER 13 — REQUIREMENTS FOR GROUP H OCCUPANCIES

Group H Occupancies Defined

Sec. 1301. Group H occcupancies shall be:

Hotels, apartment houses, dormitories, lodging houses.

Convents and monasteries (each accommodating more than 10 persons).

For occupancy separations see Table No. 5-B.

For occupant load see Section 3301.

Construction, Height and Area Allowable

Sec. 1302. (a) **General.** Buildings or parts of buildings classed in Group H because of the use or character of the occupancy shall not exceed, in area or height, the limits specified in Sections 505, 506, and 507.

(b) **Special Provisions.** Group H occupancies more than two stories in height or having more than three thousand square feet (3,000 sq. ft.) of floor area above the first floor shall be of not less than one-hour fire-resistive construction throughout.

For attic space partitions and draft stops see Section 3206.

Location on Property

Sec. 1303. For fire-resistive protection of exterior walls and openings, as determined by location on property, see Section 504.

Exit Facilities

Sec. 1304. Stairs, exits, and smokeproof enclosures shall be as specified in Chapter 33.

All stairs and exits in Group H occupancies shall open directly upon a street or alley or upon a yard or court not less than four feet (4′) in width directly connected to a street or alley by means of a passageway not less in width than the stairway opening into such passageway and not less than seven feet (7′) in height.

Buildings more than one story in height shall have no transoms or ventilating openings from guest rooms to public corridors.

Doors opening from guest rooms into public corridors shall be incombustible or of wood not less than one and three-eighths inches (1⅜″) thick at any point.

Light, Ventilation, and Sanitation

Sec. 1305. (a) **Windows.** All living rooms, kitchens, and other rooms used for living, eating, or sleeping purposes shall be provided with windows with an area not less than twelve square feet (12 sq. ft.) nor one-eighth of the floor area of such rooms. The window area in bathrooms, water-closet compartments, and other similar rooms shall not be less than three square feet (3 sq. ft.), unless adequate mechanical ventilation is provided. Not less than one-half such area shall be openable.

Required windows shall open on a court, yard, or street either directly or through a porch with a minimum clear height of not less than seven feet (7′) and a depth of not more than seven feet (7′). Such porch shall be at least 50 per cent open on at least two sides.

The width of such courts or yards shall be not less than three feet (3′) when such courts or yards are not more

Light, Ventilation, and Sanitation (Cont'd.)

than two stories high measured down from the top of the building and shall be increased at the rate of six inches (6") for each additional story in height. If such court is entirely surrounded by the building it shall have a width at least 50 per cent greater than that otherwise required.

(b) **Room Sizes and Ceiling Heights.** Every room required to have windows by Subsection (a) shall have a ceiling height of eight feet (8') in at least 50 per cent of its area. Rooms used for living, eating, or sleeping purposes shall have an area of not less than eighty square feet (80 sq. ft.). Kitchens shall have an area of not less than fifty square feet (50 sq. ft.).

(c) **Sanitation.** Every building shall be provided with at least one toilet. Every hotel and each subdivision thereof where both sexes are accommodated shall be provided with at least two toilets located in such building, which shall be conspicuously marked, one for each sex. Not less than one toilet shall be provided for each 15 persons or major fraction thereof that such building is designed to accommodate.

One toilet shall be provided for each apartment.

A kitchen sink shall be installed in every kitchen.

Enclosure of Vertical Openings

Sec. 1306. Exits shall be enclosed as specified in Chapter 33.

Elevator shafts, vent shafts and other vertical openings shall be enclosed and the enclosure shall be as set forth in Table No. 17-A. (See also Chapter 30.)

Fire-Extinguishing Systems

Sec. 1307. Automatic fire-extinguishing systems, standpipes and basement pipe inlets shall be installed as specified in Chapter 38.

Special Hazards

Sec. 1308. Chimneys and heating apparatus shall conform to the requirements of Chapters 37 and 51.

The storage and handling of gasoline, fuel oil and other flammable liquids shall not be permitted in any Group H occupancy unless such storage and handling comply with U. B. C. Standard No. 9-1.

Doors leading into rooms in which volatile flammable liquids are used or kept shall be protected by Class "C" fire doors and shall be kept normally closed.

Every boiler room or room containing a central heating plant using solid or liquid fuel shall be separated from the rest of the building by a "Three-Hour Fire-Resistive Occupancy Separation."

EXCEPTIONS: 1. Such furnaces may be used without a "Fire-Resistive Occupancy Separation" in buildings not more than two stories in height.

2. In buildings of Type V construction a "One-Hour Fire-Resistive Occupancy Separation" may be used.

Existing Buildings

Sec. 1309. For existing buildings see Appendix Section 1309.

See page 65 Sec. 1504
Groups H & I

CHAPTER 14 — REQUIREMENTS FOR GROUP I OCCUPANCIES

Group I Occupancies Defined

Sec. 1401. Group I occupancies shall be:

Dwellings.
For occupancy separations see Table No. 5-B.
For occupant load see Section 3301.

Construction, Height and Area Allowable

Sec. 1402. Buildings or parts of buildings classed in Group I because of the use or character of the occupancy shall not exceed, in area or height, the limits specified in Sections 505, 506, and 507.

Location on Property

Sec. 1403. For fire-resistive protection of exterior walls and openings, as determined by location on property, see Section 504.

Exit Facilities

Sec. 1404. Stairs and exits shall be provided as specified in Chapter 33.

Light, Ventilation and Sanitation

Sec. 1405. (a) **Windows.** All living rooms, kitchens, and other rooms used for living, eating, or sleeping purposes shall be provided with windows with an area not less than twelve square feet (12 sq. ft.) nor one-eighth of the floor area of such room. Not less than one-half such area shall be openable.

The window area in bathrooms, water-closet compartments, and other similar rooms shall not be less than three square feet (3 sq. ft.), and may open on a vent shaft which has a least dimension open and unobstructed to the sky of not less than three feet (3′).

Required windows shall open on a court, yard, or street either directly or through a porch with a minimum clear height of not less than seven feet (7′). Such porch shall be at least 50 per cent open on at least one side.

(b) **Room Sizes and Ceiling Heights.** Every room required to have windows by Subsection (a) shall have a ceiling height of not less than seven feet six inches (7′ 6″) in at least 50 per cent of its required area with no portion less than five feet (5′) in height. Rooms used for living, eating, or sleeping purposes shall have an area of not less than eighty square feet (80 sq. ft.). Kitchens shall have an area of not less than fifty square feet (50 sq. ft.).

(c) **Sanitation.** There shall be no opening from a room in which a water closet is located into a room in which food is prepared or stored.

Enclosure of Vertical Openings

Sec. 1406. Dumb-waiter shafts, clothes chutes and other vertical openings shall be enclosed and the enclosure shall be as set forth in Table No. 17-A. (See also Chapter 30.)

Fire-Extinguishing Systems

Sec. 1407. Fire-extinguishing systems when installed shall conform to the requirements of Chapter 38.

Special Hazards

Sec. 1408. Fire-extinguishing systems when installed shall conform to the requirements of Chapter 38.

Flammable liquids shall not be stored or used in Group I occupancies in quantities in excess of one gallon and all such flammable liquids shall be kept in tight or sealed containers when not in actual use.

Exceptions and Deviations

Sec. 1409. Group I occupancies constructed on the roof of multiple-storied buildings shall be considered as an additional story in so far as the construction, location, exposure, stairs, exits and fire-extinguishing apparatus are concerned.

A carport, open on two or more sides need not have a fire separation between the carport and the dwelling.

Windows between the carport and the dwelling shall not be openable. Doors shall be as required between a garage and a dwelling as set forth in Table No. 5-B.

See Section 1405 under Group H & I next pg →

CHAPTER 15 — REQUIREMENTS FOR GROUP J OCCUPANCIES

Group J Occupancies Defined

Sec. 1501. Group J occupancies shall be:

Division 1. Private garages, sheds and agricultural buildings when not over one thousand square feet (1000 sq. ft.) in area.

Division 2. Fences over six feet (6′) high, tanks and towers.

For occupancy separations see Table No. 5-B.

For occupant load see Section 3301.

Construction, Height and Area Allowable

Sec. 1502. Buildings or parts of buildings classed in Group J because of the use or character of the occupancy shall be one of the Types of Construction as specified in Part V of this Code. The floor area shall not exceed one thousand square feet (1000 sq. ft.). The height shall not exceed one story.

When any building exceeds the limit specified in this Chapter it shall be classed in the occupancy group other than Group J that it most nearly resembles.

Location on Property

Sec. 1503. For fire-resistive protection of exterior walls and openings, as determined by location on property, see Section 504.

Light and Ventilation

Sec. 1504. Private garages which are constructed in conjunction with any Group H or I occupancies and which have openings into such buildings shall be equipped with fixed louvered or screened openings or exhaust ventilation with exhaust openings located within six inches (6″) of the floor. The clear area of the louvered opening or of the openings into the exhaust ducts shall be not less than sixty square inches (60 sq. in.) per car stored in such private garage. Under no circumstances shall a private garage have any opening directly into a room used for sleeping purposes.

Special Hazards

Sec. 1505. Chimneys and heating apparatus shall conform to the requirements of Chapters 37 and 51.

Flammable liquids shall not be stored, handled or used in Group J occupancies unless such storage or handling shall comply with U. B. C. Standard No. 9-1.

PART IV

REQUIREMENTS BASED ON LOCATION IN FIRE ZONES

CHAPTER 16 — RESTRICTIONS IN FIRE ZONES

General

Sec. 1601. (a) **Fire Zones Defined.** For the purpose of this Code, the entire city is hereby declared to be and is hereby established a Fire District and said Fire District shall be known and designated as Fire Zones One, Two and Three, and shall include such territory or portions of said City as outlined in an ordinance of said City, entitled: "An Ordinance Creating and Establishing Fire Zones." Whenever in this Code reference is made to any fire zone, it shall be construed to mean one of the fire zones created by said ordinance.

(b) **Buildings Located in More than One Fire Zone.** A building or structure which is located partly in one fire zone and partly in another shall be considered to be in the more highly restricted fire zone when more than one-third of its total floor area is located in such zone.

(c) **Moved Buildings.** Any building or structure moved within or into any fire zone shall be made to comply with all the requirements for new buildings in that fire zone.

(d) **Temporary Buildings.** Temporary buildings such as reviewing stands and other miscellaneous structures conforming to the requirements of this Code, and sheds, canopies or fences used for the protection of the public around and in conjunction with construction work may be erected in Fire Zones No. 1 or 2 by special permit from the Building Official for a limited period of time, and such building or structure shall be completely removed upon the expiration of the time limit stated in such permit.

(e) **Center Lines of Streets.** For the purpose of this Chapter, the center line of an adjoining street or alley may be considered an adjacent property line. Distance shall be measured at right angles to the street or alley.

Restrictions in Fire Zone No. 1

Sec. 1602. (a) **General.** Buildings or structures hereafter erected, constructed, moved within or into Fire Zone No. 1 shall be only of Type I, II, III or IV construction and shall meet the requirements of this Section.

(b) **Limitation of Types of Construction.** Construction shall be not less than one-hour fire-resistive or as permitted in Chapter 20 for Type III, Heavy Timber construction. Exterior walls within twenty feet (20′) of adjacent property lines shall be of not less than four-hour fire-resistive construction.

EXCEPTIONS: 1. One-story Type IV buildings not more than twenty-five hundred square feet (2500 sq. ft.)

in area need not be fire protected provided they are located twenty feet (20′) from adjacent property lines. **Restrictions in Fire Zone No. 1 (Cont'd.)**

2. Walls fronting on a street having a width of at least fifty feet (50′) may be of incombustible construction with structural members fire protected as required in Part V.

(c) **Openings.** The sum of the widths of openings in exterior walls, except on street fronts, within twenty feet (20′) of adjacent property lines or other buildings on the same property shall be limited to 50 per cent of the total length of the walls affected in each story. Openings in such walls and openings within fifty feet (50′) of the opposite side of a street or public space and openings into courts which are less than twenty feet (20′) in least dimension, shall be protected by Class "E" or "F" fire doors or windows.

(d) **Alterations.** No building of Type IV construction in excess of one thousand square feet (1000 sq. ft.) in floor area nor any building of Type V construction already erected in Fire Zone No. 1 shall hereafter be altered, raised, enlarged, added to or moved, except as follows:

1. Such Type IV building may be made to conform to all the provisions of Subsections (b) and (c) of this Section.

2. Changes, alterations and repairs to the interior of such building or to the front thereof facing a public street may be made, provided such changes do not, in the opinion of the Building Official, increase the fire hazard of such building.

3. Roofs of such buildings may be covered only with a "Fire Retardant" roofing as specified in Section 3204. See Section 104(f) for repairs.

4. Such building may be moved entirely outside the limits of Fire Zone No. 1.

5. Such building may be demolished.

(e) **Occupancies Prohibited.** No Group E, Division 1 occupancy having a floor area exceeding fifteen hundred square feet (1500 sq. ft.) shall be permitted in Fire Zone No. 1.

No Group E, Division 1 or 5 occupancies shall be permitted in Fire Zone No. 1.

EXCEPTION: This shall not apply to dry cleaning plants not using highly flammable liquids.

Sec. 1603. (a) **General.** Buildings or structures hereafter erected, constructed, moved within or into Fire Zone No. 2 shall be one of the Types of Construction as defined in this Code and shall meet the requirements of this Section. **Restrictions in Fire Zone No. 2**

(b) **Limitation of Types of Construction.** Exterior walls of Type IV or V buildings or structures shall be of not less than one-hour fire-resistive construction.

For fire-resistive protection of exterior walls and openings, as determined by location on property, see Section 504.

Roof covering shall be a "Fire-Retardant" roofing as specified in Section 3204. See Section 104(f) for repairs.

Restrictions in Fire Zone No. 2 (Cont'd.)

EXCEPTIONS: 1. Exterior walls of Type IV buildings not more than one thousand square feet (1000 sq. ft.) in area are not required to be of one-hour fire-resistive construction if three feet (3') or more from adjacent property lines and six feet (6') or more from buildings on the same property.

2. Exterior walls of Type IV buildings are not required to be one-hour fire-resistive if twenty feet (20') or more from adjacent property line.

3. Exterior walls fronting on a street having a width of at least thirty feet (30') may be of incombustible construction with all structural members fire-protected as required in Part V.

(c) **Openings.** Openings except on street fronts which are less than ten feet (10') from adjacent property lines shall be protected by Class "E" or "F" fire doors or windows.

(d) **Alterations.** No building of Type IV construction in excess of one thousand square feet (1000 sq. ft.) in floor area nor any building of Type V construction except as specified in Subsection (b) already erected in Fire Zone No. 2, shall hereafter be altered, raised, enlarged, added to or moved except as follows:

1. Such building may be made to conform to the provisions of Subsection (b) of this Section.

2. Changes, alterations and repairs to the interior of such building or to the front thereof facing a public street may be made provided such changes do not, in the opinion of the Building Official, increase the fire hazard of such building.

3. Roofs of such buildings may be covered only with a "Fire Retardant" roofing as specified in Section 3204. See Section 104(f) for repairs.

4. Such building may be moved entirely outside the limits of Fire Zone No. 2.

5. Such building may be demolished.

6. Combustible finish on the outside of walls may be replaced by, or covered with exterior plaster as specified in Chapter 47.

(e) **Occupancies Prohibited.** No Group E, Division 1 occupancy, having a floor area exceeding fifteen hundred square feet (1500 sq. ft.) shall be permitted in Fire Zone No. 2.

No Group E, Division 1 or 5 occupancies shall be permitted in Fire Zone No. 2.

EXCEPTION: This shall not apply to dry cleaning plants not using highly flammable liquids.

Restrictions in Fire Zone No. 3

Sec. 1604. (a) **General.** Any building or structure complying with the requirements of this Code may be erected, constructed, moved within or into Fire Zone No. 3.

PART V

REQUIREMENTS BASED ON TYPES OF CONSTRUCTION

CHAPTER 17 — CLASSIFICATION OF ALL BUILDINGS BY TYPES OF CONSTRUCTION AND GENERAL REQUIREMENTS

General

Sec. 1701. The requirements of Part V are minimum for the various Types of Construction and represent varying degrees of public safety and resistance to fire. Every building shall be classified by the Building Official into one of the Types of Construction set forth in Table No. 17-A. Any building which does not entirely conform to a Type of Construction set forth in Table No. 17-A shall be classified by the Building Official into a type having an equal or lesser degree of fire-resistance.

No building or portion thereof shall be required to conform to the details of a Type of Construction higher than that Type which meets the minimum requirements based on Occupancy (Part III) or Location in Fire Zone (Part IV) even though certain features of such building actually conform to a higher Type of Construction.

Where specific materials, types of construction or fire-resistive protection are required, such requirements shall be the minimum requirements and any materials, types of construction or fire-resistive protection which will afford equal or greater public safety or resistance to fire, as specified in this Code, may be used.

Portions of buildings separated as specified in Sec. 505 (c) may be considered a separate building for classification of types of construction. When there is no such separation, the area of the entire building shall not exceed the least area permitted for the types of construction involved.

Structural Frame

Sec. 1702. The structural frame shall be considered to be the columns and the girders, beams, trusses and spandrels having direct connections to the columns and all other members which are essential to the stability of the building as a whole. The members of floor or roof panels which have no connection to the columns, shall be considered secondary members and not a part of the structural frame.

Usable Space Under Floors

Sec. 1703. Usable space under the first floor shall be enclosed except in Group I and J occupancies and such enclosure when constructed of metal or wood shall be protected on the side of the usable space as required for one-hour fire-resistive construction. Doors shall be self-closing incombustible or solid core wood not less than one and three-eights inches (1⅜") in thickness.

Roof Coverings

Sec. 1704. Roof covering shall be "Fire-Retardant" except in Type V buildings housing Groups H, I, or J occupancies it may be "Ordinary", as specified in Section 3204.

TABLE NO. 17-A—TYPES OF CONSTRUCTION—FIRE-RESISTIVE REQUIREMENTS
(In Hours)
(For Details see Chapters under Occupancy and Types of Construction)

MATERIALS OF CONSTRUCTION	I	II	III		IV		V	
	Incombustible	Incombustible	1-Hr. or H.T.	N	1-Hour	N	1-Hour	N
			Combustible		Incombustible		Combustible	
Ext. Bearing Walls	4 Sec. 1803 (a)	4 Sec. 1903 (a)	4 Sec. 2003 (a)	4 Sec. 2003 (a)	1	N	1	N
Int. Bearing Walls	3	1	1	N	1	N	1	N
Ext. Non-Bearing Walls	Sec. 1803 (a)	Sec. 1903 (a)	4 Sec. 2003 (a)	4	1	N	1	N
Structural Frame	3	2	1 or H.T.	N	1	N	1	N
Partitions—Perm.	1	1	1 or H.T.	N	1	N	1	N
Vertical Openings	2	2	1 or H.T.	1	1	1	1 Sec. 2203	1 Sec. 2203
Floors	2	1	1 or H.T.	N	1	N	1	N
Roofs	2 Sec. 1806	1 Sec. 1906	1 or H.T.	N	1 Sec. 2106	N	1	N
Exterior Doors and Windows	Sec. 1803 (b)	Sec. 1903 (b)	Sec. 2003 (b)	N	N	N	N	N
Inner Court Walls	3 Sec. 1803 (a)	2 Sec. 1903 (a)	1 or H.T.	1	1	N	1	N

N—No general requirements for fire resistance. H.T.—Heavy Timber.

Skylights shall be constructed as required in Chapter 34.

Penthouses shall be constructed as required in Chapter 36.

Unprotected Materials Allowed

Sec. 1705. (a). **Partitions.** Regardless of the fire-resistive requirements for permanent partitions, temporary partitions dividing portions of stores, offices or similar places occupied by one tenant only may be constructed of wood panels or similar light construction up to three-fourths the height of the room in which placed; when more than three-fourths the height of the room, such partitions shall have not less than the upper one-fourth of the partition constructed of glass.

(b) **Show Windows and Cases.** Show window frames, aprons, show cases and other appurtenances on the first floor of stores or other similar occupancies may be of wood or unprotected steel or iron.

(c) **Trim.** Trim, picture molds, chair rails, baseboards, hand rails, show window backing may be of wood. Unprotected wood doors may be used except where fire-resistive doors are required.

Materials used for interior finish of walls and ceilings, including wainscoting, shall be as specified in Chapter 42.

(d) **Loading Platforms.** Exterior loading platforms may be of heavy timber construction with wood floors not less than two inches (2") nominal thickness. Such wood construction shall not be carried through the exterior walls.

(e) **Insulating Boards.** Combustible insulating boards may be used under finished flooring.

Enclosure of Vertical Openings

Sec. 1706 (a). **General.** Enclosures for elevator shafts, vent shafts, and other vertical openings, except as specified in Section 2203 for Type V buildings, shall be as set forth in Table No. 17-A and all openings therein shall be protected by Class "E" or "F" fire doors for exterior openings and Class "B" doors for interior openings. (See Chapter 30.)

(b) **Construction.** Exit enclosures shall be constructed as specified in Section 3308.

(c) **Guard Rail.** A parapet wall, or hand rail, which is at least thirty-six inches (36") in height shall be provided around all open shaft enclosures extending through the roof.

Weather Protection

Sec. 1707 (a). **Building Paper.** Asphalt-saturated felt free from holes and breaks and weighing not less than 14 pounds per hundred square feet (100 sq. ft.) or approved waterproof paper, shall be applied over studs or sheathing of all exterior walls. Such felt or paper shall be applied weatherboard fashion, lapped not less than two inches (2") at horizontal joints and not less than six inches (6") at vertical joints.

Building paper may be omitted in the following cases:

1. When exterior covering is of approved weatherproof panels.
2. In back-plastered construction.
3. When there is no human occupancy.

4. Over water-repellent panel sheathing.

(b) **Flashing.** Exterior openings exposed to the weather shall be flashed with rust-resistive metal or other approved flashing in such a manner as to make them waterproof.

Members Carrying Masonry

Sec. 1708. All members carrying masonry in buildings over one story in height shall be fire-protected with not less than one-hour fire-protection.

EXCEPTION: Fire protection may be omitted from the bottom flange of lintels, shelf angles or plates that are not a part of the structural frame.

Parapets

Sec. 1709. Parapet walls not less than thirty inches (30") in height shall be provided on exterior walls of buildings when the walls are required to be fire-resistant due to their location on property as set forth in Table No. 5-A, and inner court enclosures.

A parapet wall shall have the same fire resistance as required for the wall itself.

EXCEPTIONS: Parapets shall not be required on the following walls:

1. When the roof construction is entirely incombustible.

2. When the roof has an angle of more than 20 degrees with horizontal.

Cornices

Sec. 1710. Except in Type V construction, cornices and similar appendages shall be constructed of substantial incombustible materials and when over public property as specified in Chapter 45.

CHAPTER 18 — TYPE I BUILDINGS

Definition

Sec. 1801. The structural elements in Type I Buildings shall be of steel, iron, concrete, or masonry.

Walls and permanent partitions shall be of incombustible fire-resistive construction.

Materials of construction and fire-resistive requirements shall be as specified in Chapter 17.

Structural Framework

Sec. 1802. Structural framework shall be of structural steel or iron as specified in Chapter 27, reinforced concrete in Chapter 26 or of reinforced masonry in Chapter 24.

For additional requirements for Group E occupancies, see Section 1002 (b).

Exterior Walls and Openings

Sec. 1803 (a). **Exterior and Inner Court Walls.** Exterior walls and inner court walls shall be as set forth in Table No. 17-A, except that walls fronting on streets having a width of at least fifty feet (50′) in Fire Zone No. 1 or thirty feet (30′) in Fire Zones Nos. 2 and No. 3 may be of unprotected incombustible construction with all structural members fire-protected as set forth in Table No. 17-A.

EXCEPTION: 1. In Group F, G, and H occupancies exterior and inner court bearing walls may be two-hour fire-resistive where openings are permitted.

2. In other than Group E occupancies exterior and inner court non-bearing walls may be one-hour fire-resistive construction where unprotected openings are permitted and two-hour fire-resistive construction where fire protection of openings is required.

(b) **Doors and Windows.** Doors, windows and other openings in the exterior walls in Type I buildings shall be protected by Class "E" or "F" fire doors or windows.

EXCEPTIONS: 1. The provisions of this Subsection shall not apply to doors, windows and other openings which face directly upon, and are not within fifty feet (50′) in Fire Zone No. 1 or are not within thirty feet (30′) in Fire Zones No. 2 and No. 3, of the opposite side of a public street or other public place, this distance to be measured at right angles to the plane of the wall in which such openings occur.

2. The provisions of this Subsection shall not apply to openings in an outer court twenty feet (20′) or more in width parallel to and facing upon a street or public place, provided such openings are not within twenty feet (20′) of an adjacent property line.

Floors

Sec. 1804. (a) **Wood Sleepers.** Where wood sleepers are used for laying wood flooring on masonry or concrete fire-resistive floors the space between the floor slab and the underside of the wood flooring shall be filled with incombustible material in such a manner that there will be no open spaces under the flooring which will exceed one hundred square feet (100 sq. ft.) in area and such space shall be filled solidly under all permanent partitions so that there is no communication under the flooring between adjoining rooms.

Floors (Cont'd.)

(b) **Mezzanine Floors.** Mezzanine floors may be of wood or unprotected steel except that in Fire Zone No. 1 they shall be of incombustible materials as approved for one-hour fire-resistive construction or of heavy timber construction as specified for floors in Section 3106.

Not more than two mezzanine floors shall be in any room of a building.

No mezzanine floor or floors shall cover more than 33⅓ per cent of the area of any room.

Stair Construction

Sec. 1805. Stairs and stair platforms shall be constructed of reinforced concrete, iron or steel with treads and risers of concrete, iron or steel. Brick, marble, tile or other hard incombustible materials may be used for the finish of such treads and risers.

Stairs shall be designed and constructed as specified in Chapter 33.

Roofs

Sec. 1806. Roofs more than twenty-five feet (25′) above any floor, balcony, or gallery may be of unprotected incombustible materials.

Where every part of the structural steel framework of the roof of a Group A, B, or C occupancy is not less than twenty-five feet (25′) above any floor, balcony, or gallery, fire protection of all members of the roof construction may be omitted.

Where every part of the structural steel framework of the roof of a Group A, B or C occupancy is more than eighteen feet (18′) and less than twenty-five feet (25′) above any floor, balcony or gallery, the roof construction shall be protected by a ceiling of not less than one-hour fire-resistive construction.

Roofs may be sheathed by wood planks of two and one-half inch (2½″) nominal thickness when such sheathing is more than thirty feet (30′) distant from any floor, balcony or gallery and when such plank sheathing is protected on the underside by a ceiling of not less than one-hour fire-resistive construction.

CHAPTER 19—TYPE II BUILDINGS

Definition

Sec. 1901. The structural elements in Type II buildings shall be of steel, iron, concrete or masonry.

Walls and permanent partitions shall be of incombustible fire-resistive construction.

Materials of construction and fire-resistive requirements shall be as specified in Chapter 17.

Structural Framework

Sec. 1902. Structural framework shall be of structural steel or iron as specified in Chapter 27, reinforced concrete in Chapter 26 or of reinforced masonry in Chapter 24.

Exterior Walls and Openings

Sec. 1903 (a). **Exterior and Inner Court Walls.** Exterior walls and inner court walls shall be as set forth in Table No. 17-A, except that walls fronting on streets having a width of at least fifty feet (50′) in Fire Zone No. 1 or thirty feet (30′) in Fire Zones Nos. 2 and No. 3 may be of unprotected incombustible construction with all structural members fire-protected as set forth in Table No. 17-A.

EXCEPTION: 1. In Group F, G, and H occupancies exterior and inner court bearing walls may be two-hour fire-resistive where openings are permitted.

2. In other than Group E occupancies exterior and inner court non-bearing walls may be one-hour fire-resistive construction where unprotected openings are permitted and two-hour fire-resistive construction where fire protection of openings is required.

(b) **Doors and Windows.** Doors, windows and other openings in the exterior walls in Type II buildings shall be protected by Class "E" or "F" fire doors or windows.

EXCEPTIONS: 1. The provisions of this Subsection shall not apply to doors, windows and other openings which face directly upon, and are not within fifty feet (50′) in Fire Zone No. 1 or are not within thirty feet (30′) in Fire Zones No. 2 and No. 3 of the opposite side of a public street or other public place, this distance to be measured at right angles to the plane of the wall in which such openings occur.

2. The provisions of this Subsection shall not apply to openings in an outer court twenty feet (20′) or more in width parallel to and facing upon a street or public place, provided such openings are not within twenty feet (20′) of an adjacent property line.

Floors

Sec. 1904. (a) **General.** Where wood sleepers are used for laying wood flooring on masonry or concrete fire-resistive floors the space between the floor slab and the underside of the wood flooring shall be filled with incombustible material in such a manner that there will be no open spaces under the flooring which will exceed one hundred square feet (100 sq. ft.) in area and such space shall be filled solidly under all permanent partitions so that there is no communication under the flooring between adjoining rooms.

(b) **Mezzanine Floors.** Mezzanine floors may be of wood or unprotected steel except that in Fire Zone No. 1 they

shall be of incombustible materials as approved for one-hour fire-resistive construction or of heavy timber construction as specified for floors in Section 3106.

Not more than two mezzanine floors shall be in any room of a building.

No mezzanine floor or floors shall cover more than 33⅓ per cent of the area of any room.

Stair Construction

Sec. 1905. Stairs and stair platforms shall be constructed of reinforced concrete, iron or steel with treads and risers of concrete, iron or steel. Brick, marble, tile or other hard incombustible materials may be used for the finish of such treads and risers.

All stairs shall be designed and constructed as specified in Chapter 33 and as required under Occupancy in Part III.

Roofs

Sec. 1906. Roofs more than twenty-five feet (25′) above any floor, balcony, or gallery may be of unprotected incombustible materials.

Where every part of the structural steel framework of the roof of a Group A, B, or C occupancy is not less than twenty-five feet (25′) above any floor, balcony, or gallery, fire protection of all members of the roof construction may be omitted.

Where the structural steel framework of the roof of a Group A, B, or C occupancy is more than eighteen feet (18′) and less than twenty-five feet (25′) above any floor, balcony, or gallery, the roof construction shall be protected by a suspended ceiling of not less than one-hour fire-resistive construction.

Roofs may be sheathed by wood planks of two and one-half inch (2½″) nominal thickness when such sheathing is more than thirty feet (30′) distant from any floor, balcony or gallery and when such plank sheathing is protected on the underside by a ceiling of not less than one-hour fire-resistive construction.

CHAPTER 20 — TYPE III BUILDINGS

Definition

Sec. 2001. Structural elements of Type III buildings may be of any materials permitted by this Code.

Type III, One-Hour buildings shall be one-hour fire-resistive construction throughout.

Type III, Heavy Timber Buildings, shall be Heavy Timber Construction. Exterior walls shall be of incombustible fire-resistive construction.

Materials of construction and fire-resistive requirements shall be as specified in Chapter 17.

For requirements due to occupancy, see Chapters 6 to 13, inclusive.

For requirements in Fire Zones see Chapter 16.

Structural Framework

Sec. 2002. (a). **General.** The structural framework shall be of steel or iron as specified in Chapter 27, concrete in Chapter 26, masonry in Chapter 24 or wood in Chapter 25 and this Chapter.

(b) **Heavy Timber Structure.** All wood columns in such structural frame shall be directly superimposed, one above the other (no girders or bolsters between columns), and shall be provided with reinforced concrete, steel or cast iron caps, pintles or base plates, or be connected by timber splice blocks fastened to columns by connectors housed within the contact faces or by bolts. No wood column shall be less than eight inches (8") nominal in its least dimension; no beam, girder or joist shall be less than six inches (6") nominal in its least dimension, nor less than forty-eight square inches (48 sq. in.) nominal in cross-sectional area; and no wood roof truss or arch framing member shall be less than four inches (4") nominal in least dimension, except that top and bottom chords of truss may be built up of two or more elements of not less than three inches (3") nominal thickness when the space between such elements is either solidly filled or is tightly closed for the full length on the underside thereof with a wood cover plate of two-inch (2") nominal thickness.

Where adjoining ends of girders and beams meet at columns they shall be closely fitted and cross-tied by approved reinforced concrete, steel or iron post caps or metal straps, or shall be inter-tied with columns by through bolted wood corbel and splice blocks or side bolsters with load transferred by connectors housed within the contacting faces or by bolts. Approved wall plates, boxes or hangers shall be provided where wood beams, girders or trusses rest on masonry or concrete walls.

Exterior Walls, Openings and Partitions

Sec. 2003 (a). **Exterior Walls.** Exterior walls shall be of not less than four-hour fire-resistive construction, except that walls fronting on streets having a width of at least fifty feet (50') in Fire Zone No. 1 or thirty feet (30') in Fire Zones No. 2 and No. 3 may be of incombustible construction with all structural members fire-protected as set forth in Table No. 17-A.

Exterior Walls, Openings and Partitions (Cont'd.)

(b) **Doors and Windows.** Doors, windows and other openings in the exterior walls in Type III one-hour and Heavy Timber buildings shall be protected by Class "E" or "F" fire doors or windows.

EXCEPTIONS: 1. The provisions of this Subsection shall not apply to doors, windows and other openings which face directly upon, and are not within fifty feet (50') in Fire Zone No. 1 or are not within thirty feet (30') in Fire Zones No. 2 and No. 3 of the opposite side of a public street or other public space, this distance to be measured at right angles to the plane of the wall in which such openings occur.

2. The provisions of this Subsection shall not apply to openings in an outer court twenty feet (20') or more in width parallel to and facing upon a street or public place, provided such openings are not within twenty feet (20') of an adjacent property line.

(c) **Partitions.** Permanent partitions in Type III One-Hour buildings shall be of one-hour fire-resistive construction. In Type III Heavy Timber buildings they shall be of solid wood construction formed by not less than two layers of one-inch (1") nominal matched boards or laminated construction three and five-eighths inches (3⅝") thick, or of one-hour fire-resistive construction. Bearing partitions when constructed of wood, shall not support more than two stories and a roof. Partitions shall be constructed as specified in Sec. 2521 (k).

Floors

Sec. 2004 (a). **General.** Floors may be constructed as specified in Chapter 26 for concrete, Chapter 24 for masonry, Chapter 25 for wood, and Chapter 27 for steel or iron.

Wood joists, beams and girders supported by masonry walls shall be anchored thereto as specified in Section 2517 (g). Ventilation shall be provided between the ground and a wood floor as specified in Section 2523.

(b) **Heavy Timber Floors.** Heavy timber floors shall be constructed as specified in Section 3106.

(c) **Wood Sleepers.** Where wood sleepers are used for laying wood flooring on masonry or concrete fire-resistive floors the space between the floor slab and the underside of the wood flooring shall be filled with incombustible material in such a manner that there will be no open spaces under the flooring which will exceed one hundred square feet (100 sq. ft.) in area and such space shall be filled solidly under all partitions so that there is no communication under the flooring between adjoining rooms.

(d) **Mezzanine Floors.** Mezzanine floors may be of wood or unprotected steel except that in Fire Zone No. 1 they shall be of incombustible materials as approved for one-hour fire-resistive construction or of heavy timber construction as specified for floors in Section 3106.

Not more than two mezzanine floors shall be in any room of a building.

No mezzanine floor or floors shall cover more than 33⅓ per cent of the area of any room.

Stair Construction

Sec. 2005. Stairs shall be constructed with any material allowed in this Code except that in Heavy Timber buildings stairs may be constructed with wood treads and risers of not less than two-inch (2") nominal thickness, except where built on laminated or plank inclines as required for floors, when they may be of one-inch (1") nominal thickness or may be constructed as required in Type I buildings.

In buildings four or more stories in height, stairs and stair construction shall be as required for Type I buildings.

Stairs and exits shall be designed and constructed as specified in Chapter 33.

Roofs

Sec. 2006. Roof decks shall be as required for floors in Section 2004. In heavy timber buildings roofs shall be constructed of tongued and grooved or splined lumber of not less than two inches (2") nominal thickness or of square-edged lumber of not less than three inches (3") nominal width set on edge and securely spiked together.

CHAPTER 21 — TYPE IV BUILDINGS

Definition

Sec. 2101. The structural elements of Type IV buildings shall be of incombustible materials.

Type IV, One-Hour Buildings, shall be of incombustible construction and one-hour fire-resistive throughout.

Walls and permanent partitions shall be of incombustible materials.

Materials of construction and fire-resistive requirements shall be as specified in Chapter 17.

For requirements due to occupancy, see Chapters 6 to 13, inclusive.

For requirements in Fire Zones see Chapter 16.

Structural Framework

Sec. 2102. The structural framework shall be as specified in Chapter 27 for iron and steel, Chapter 26 for concrete, and Chapter 24 for masonry.

Exterior Walls

Sec. 2103. Exterior wall covering shall provide suitable protection from the elements and shall be of incombustible materials. Wall coverings may be considered a structural part of the structural frame if designed and constructed to act integrally therewith.

Walls shall be thoroughly and effectively braced, and effectively fire-stopped at all floor and ceiling levels with incombustible materials. Steel studs shall be designed in accordance with Chapter 27.

Floor Construction

Sec. 2104. Floor construction shall be of incombustible material, provided, however, that a wood wearing surface or finish may be applied over such incombustible material.

Stair Construction

Sec. 2105. Stairs shall be of any type permitted by this Code and shall comply with the requirements of Chapter 33.

Roof Construction

Sec. 2106. Roofs shall be of incombustible construction. In Type IV, One-Hour Buildings, roofs may be as specified in Section 1806.

Roof covering shall be a "Fire-Retardant" roofing as specified in Section 3204.

CHAPTER 22—TYPE V BUILDINGS

Definition

Sec. 2201. Type V buildings may be of any materials allowed by this Code.

Type V, One-Hour Buildings, shall be of one-hour fire-resistive construction throughout.

Materials of construction and fire-resistive requirements shall be as specified in Chapter 17.

For requirements due to occupancy, see Chapters 6 to 13, inclusive.

For requirements in Fire Zones, see Chapter 16.

Sheathing

Sec. 2202. Type V buildings three stories in height shall have all exterior walls of the first story, covered with solid sheathing as specified in this Subsection. Such sheathing when of wood, shall be applied diagonally.

Sheathing shall be one or more of the following materials:

Wood not less than five-eighths inch (⅝") thick.

Fiberboard not less than seven-sixteenths inch (7/16") thick complying with U. B. C. Standard No. 22-1.

Gypsum sheathing not less than one-half inch (½") thick complying with U. B. C. Standard No. 22-2.

Plywood not less than five-sixteenths inch (5/16") thick complying with U. B. C. Standard No. 25-3.

Enclosure of Vertical Openings

Sec. 2203. Enclosure walls for elevator shafts, vent shafts, and similar vertical openings shall be of not less than one-hour fire-resistive construction, except that chutes and dumb-waiter shafts with a cross-sectional area of not more than nine square feet (9 sq. ft.) may be lined with approved incombustible materials covered with not less than 26 U. S. gauge sheet metal with all joints in such sheet metal lock-lapped. (See Chapter 30.) All openings into any such vertical enclosure shall be protected by metal or metal-clad doors with either metal or metal-clad jambs, casings or frames.

Exit enclosures shall be constructed as specified in Section 3308.

Stair Construction

Sec. 2204. Stair construction may be of any type permitted in this Code and shall conform to the requirements of Chapter 33.

PART VI

ENGINEERING REGULATIONS—QUALITY AND DESIGN OF THE MATERIALS OF CONSTRUCTION

CHAPTER 23 — LIVE AND DEAD LOADS

Definitions

Sec. 2301. Dead Load. The dead load of a building shall include the weight of the walls, permanent partitions, framing, floors, roofs and all other permanent stationary construction entering into and becoming a part of a building.

Live Load. The live load includes all loads except dead and lateral loads.

Loads

Sec. 2302. (a) General. Buildings and all parts thereof shall be of sufficient strength to support the estimated or actual imposed dead and live loads in addition to their own proper dead load, without exceeding the stresses noted elsewhere in this Code, provided that no building or part thereof shall be designed for live loads less than those specified in the following Sections. Impact shall be considered in the design of any structure where impact loads occur.

(b) **Special.** Provision shall be made in designing office floors for load of 2000 pounds placed upon any space two and one-half feet (2½') square wherever this load upon an otherwise unloaded floor would produce stresses greater than those caused by a uniformly distributed load of 50 pounds per square foot.

In designing floors to be used for industrial or commercial purposes the actual live load caused by the use to which the building or part of the building is to be put, shall be used in the design of such building or part thereof, and special provision shall be made for machine or apparatus loads when such machine or apparatus would cause a greater load than specified for such use in Section 2304.

Floors in office buildings and in other buildings, where partition locations are subject to change, shall be designed to support, in addition to all other loads, a uniformly distributed load equal to 20 pounds per square foot.

Public garages and commercial or industrial buildings in which loaded trucks are placed, used or stored shall have the floor systems designed to support a concentrated rear wheel load of a loaded truck placed in any possible position.

Method of Design

Sec. 2303. Any system or method of construction to be used shall admit of a rational analysis in accordance with well established principles of mechanics.

Unit Live Loads

Sec. 2304. The unit loads set forth in Table No. 23-A shall be taken as the minimum live loads in pounds per square foot of horizontal projection to be used in the design of buildings for the occupancies listed, and loads at least equal shall be assumed for uses not listed in this Section but which create or accommodate similar loadings.

TABLE NO. 23-A. — UNIT LIVE LOADS

Unit Live Loads (Cont'd.)

Apartments	40
Armories	150
Auditoriums—Fixed Seats	50
Movable Seats	100
Balconies and Galleries—Fixed Seats	50
Movable Seats	100
Cornices	60
Corridors, Public	100
Dance Halls	100
Drill Rooms	100
Dwellings	40
Exterior Balconies	100
Fire Escapes	100
Garages	100
Gymnasiums	100
Hospitals—Wards and Rooms	40
Hotels—Guest Rooms and Private Corridors	40
Libraries—Reading Rooms	60
Stack Rooms	125
Loft Buildings	100
Manufacturing — Light	75
Heavy	125
Marquees	60
Offices	50
Printing Plants—Press Rooms	150
Composing and Linotype Rooms	100
Public Rooms	100
Rest Rooms	50
Reviewing Stands and Bleachers	100
Roof Loads	(See Section 2305)
Schools—Class Rooms	40
Sidewalks	250
Skating Rinks	100
Stairways	100
Storage — Light	125
Heavy (Load to be determined from proposed use or occupancy, but never less than)	250
Stores—Retail (Light Merchandise)	75
Wholesale (Light Merchandise)	100

All ceiling joists shall be designed for not less than 10 pounds per square foot total load.

All balcony railings shall be designed to withstand a horizontal force of 20 pounds per lineal foot, applied at the top of the railing.

Roof Loads

Sec. 2305. Roofs shall sustain, within the stress limitations of this Code, all "dead loads" plus unit "live loads" set forth in Table No. 23-B. The live loads shall be assumed to act vertically upon the area projected upon a horizontal plane.

Greenhouses, lath houses and agricultural buildings shall be designed for a vertical live load of not less than 10 pounds.

Roof Loads (Cont'd.)

TABLE NO. 23-B—ROOF LIVE LOADS IN POUNDS PER SQUARE FOOT

TRIBUTARY LOADED AREA IN SQUARE FEET FOR ANY STRUCTURAL MEMBER	0 to 200	201 to 600	Over 600
Roof member			
Flat or rise less than 4 inches per foot. Arch or dome with rise less than 1/8 of the span.	20	16	12
Rise 4 inches per foot to less than 12 inches per foot. Arch or dome with rise 1/8 span to less than 3/8 span or with radius 3/4 or greater of the span.	16	14	12
Rise 12 inches per foot and greater. Arch or dome with rise 3/8 span or greater, or radius less than 3/4 of the span.	12	12	12

Trusses and arches shall be designed to resist the stresses caused by unit live loads on one-half of the span if such loading results in reverse stresses, or stresses greater in any portion than the stresses produced by the required unit live load upon the entire span. For roofs whose structure is composed of a stressed shell, framed or solid, wherein stresses caused by any point loading are distributed throughout the area of the shell, the requirements for unbalanced unit live load design may be reduced 50 per cent.

When the form factor, as determined by wind tunnel tests or other recognized methods, indicates vertical or horizontal loads of lesser or greater severity than those produced by the loads herein specified, the roof structure may be designed accordingly.

Snow load, full or unbalanced, or wind load shall be considered in place of loads in Table No. 23-B, where such loading will result in larger members or connections.

Reduction of Live Loads

Sec. 2306. The following reductions in unit live loads shown in Table No. 23-A for floors shall be permitted in the designing of columns, piers, walls, foundations, trusses, beams and flat slabs.

Except for places of public assembly, and except for live loads greater than 100 pounds per square foot, the design live load on any member supporting one hundred fifty square feet (150 sq. ft.) or more may be reduced at the rate of 0.08 per cent per square foot of area supported by the

member. The reduction shall not exceed 60 per cent nor "R" as determined by the following formula: **Reduction of Live Loads (Cont'd.)**

$$R=23.1\left(1+\frac{D}{L}\right)$$

WHERE

R=Reduction in per cent

D=Dead load per square foot of area supported by the member

L=Unit live load per square foot of area supported by the member

For storage live loads exceeding 100 pounds per square foot, no reduction shall be made except design live loads on columns may be reduced 20 per cent.

Sec. 2307. (a) General. Buildings and structures and every portion thereof shall be designed and constructed to resist the wind pressure specified in this Section. All bracing systems both horizontal and vertical shall be designed and constructed to transfer the wind loads to the foundations. **Wind Pressure**

(b) Wind Pressure. For purposes of design the wind pressure shall be taken upon the gross area of the vertical projection of buildings and structures at not less than 15 pounds per square foot for those portions of the building less than sixty feet (60′) above ground and at not less than 20 pounds per square foot for those portions more than sixty feet (60′) above ground.

The wind pressure upon roof tanks, roof signs, or other exposed roof structures and their supports shall be taken as not less than 30 pounds per square foot of the gross area of the plane surface, acting in any direction. In calculating the wind pressure on circular tanks, towers or stacks this pressure shall be assumed to act on six-tenths of the projected area.

On open framed structures the area used in computing wind pressure shall be one and one-half times the net area of the framing members in the side exposed to the wind.

Greenhouses, lath houses and agricultural buildings, shall be designed for a wind pressure of not less than 10 pounds per square foot.

(c) Design. The overturning moment calculated from the wind pressure shall in no case exceed two-thirds of the dead load resisting moment.

The weight of earth superimposed over footings may be used to calculate the dead load resisting moment.

For members carrying wind stresses only, and for combined stresses due to wind and other loads, the allowable unit stresses and the allowable loads on connections may be increased 33⅓ per cent. In no case shall the section be less than required if the wind stress be neglected.

(d) Combined Wind and Live Loads. For the purpose of determining stresses all vertical design loads except the roof live load and crane loads shall be considered as acting simultaneously with the wind pressure.

Sec. 2308. The live loads for which each floor or part thereof of a commercial or industrial building is or has been designed, shall have such designed live loads conspicuously **Live Loads Posted**

posted by the owner in that part of each story in which they apply, using durable metal signs, and it shall be unlawful to remove or deface such notices. The occupant of the building shall be responsible for keeping the actual load below the allowable limits.

Retaining Walls and Basement Floors

Sec. 2309. Retaining walls shall be designed to resist the lateral pressure of the retained material in accordance with accepted engineering practice. Walls retaining drained earth may be designed for pressure equivalent to that exerted by a fluid weighing not less than 30 pounds per cubic foot and having a depth equal to that of the retained earth. Any surcharge shall be in addition to the equivalent fluid pressure.

Footing Design

Sec. 2310. Footings shall be designed to minimize differential settlement.

Walls and Structural Framing

Sec. 2311. Walls and structural framing shall be erected true and plumb in accordance with the design. Bracing shall be placed during erection wherever necessary to take care of all loads to which the structure may be subjected.

Earthquake Regulations

Sec. 2312. For provisions covering Lateral Bracing (Earthquake Regulations) see Appendix Section 2312 and Seismic Probability Map of the United States on inside back cover.

CHAPTER 24 — MASONRY

General

Sec. 2401. (a) Quality and Design. The quality of masonry materials shall conform to the minimum requirements specified in this Chapter. Masonry units may be re-used when clean, sound, and conforming to the other requirements of this Chapter. Masonry construction shall conform to the detailed minimum requirements specified in this Chapter. Where Section 2312 is applicable, masonry shall also be designed in accordance with the allowable stresses specified in this Chapter.

(b) **Combination of Units.** Where units of different types or strengths are used in combination, the maximum allowable stress for the combination shall not exceed that allowed for masonry of the units having the lowest allowable stress.

(c) **Freezing.** All masonry shall be protected against freezing for at least 48 hours after being laid. No masonry shall be built upon frozen material.

(d) **Dimensions.** Dimensions given are nominal; actual dimensions of unit masonry may not be decreased by more than one-half inch (½").

Materials*

Sec. 2402. (a) Brick. Building brick of clay, shale, sand-lime, or concrete shall be of a quality at least equal to that required by U.B.C. Standards Nos. 24-1, 24-2, or 24-3. When in contact with the ground or where severe frost action occurs in the presence of moisture, the brick shall be of at least Grade MW for clay, shale, or sand-lime brick; or Grade A for concrete brick. Other solid masonry units of clay or shale shall meet the requirements for the physical properties of brick as specified in U.B.C. Standard No. 24-1.

(b) **Concrete Masonry Units.** Concrete masonry units shall be of a quality at least equal to that required by U.B.C. Standard No. 24-4 or No. 24-5, when used for bearing walls or piers, or when in contact with ground or exposed to the weather; or equal to U.B.C. Standard No. 24-6, when used for non-bearing purposes and not exposed to the weather.

(c) **Structural Clay Tile.** Structural clay tile shall be of a quality at least equal to that required by U.B.C. Standard No. 24-7, Grade LB when used for bearing walls or piers, or Grade LBX when exposed to the weather or soil; or equal to U.B.C. Standard No. 24-8, when used for interior non-load-bearing purposes; or equal to U.B.C Standard No. 24-9, when used for floor construction.

(d) **Stone.** Natural stone shall be sound and free from loose or friable inclusions, with sufficient strength and durability for the proposed use.

(e) **Gypsum Units.** Gypsum partition tile or block shall be of a quality at least equal to that required by U.B.C. Standard No. 24-10.

(f) **Structural Glass Block.** Structural glass block shall be precoated with a material to improve adhesion on all mortar bearing surfaces.

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*For regulations covering PLAIN CONCRETE, see Section 2624.

Materials (Cont'd.)

TABLE NO. 24-A—TYPES OF MORTAR

TYPE	MINIMUM COMPRESSIVE STRENGTH OF 2-IN. CUBES AT 28 DAYS, LB. PER SQ. IN.
A-1	2,500
A-2	1,800
B	600

(g) **Glazed Building Units.** Glazed brick shall conform to the structural requirements for building brick of clay or shale, and glazed structural tile shall conform to the structural requirements for structural clay tile.

(h) **Cementitious Materials.** Cementitious materials used in mortars shall be of a quality at least equal to the quality of materials required by the following applicable specifications: U.B.C. Standard No. 24-12; U.B.C. Standard No. 24-13; U.B.C. Standard N. 24-14; U.B.C. Standard No. 24-15; U.B.C. Standard No. 24-16; U.B.C. Standard No. 26-1; U.B.C. Standard No. 24-17.

(i) **Aggregate.** Aggregate for mortar shall be of a quality at least equal to that required by U.B.C. Standard No. 24-18.

(j) **Cast Stone.** Cast stone shall be of a quality at least equal to that required by U.B.C. Standard No. 24-19.

(k) **Water.** Water used in mixing mortar shall be clean, and free from deleterious amounts of acids, alkalies, or organic materials.

Mortar and Grout

Sec. 2403. (a) **General.** Mortar other than gypsum mortar used in masonry construction shall be classified as set forth in Table No. 24-A.

Mortar when applied shall have a flow after suction for one minute of not less than 70 per cent of that immediately before suction when determined by the method of the water retention test of U.B.C. Standard No. 24-16.

Tests made to classify mortar by compressive strength shall be made as described in U.B.C. Standard No. 24-16, using the proportions and materials proposed for use.

(b) **Strength.** Unless the strength classification of the mortar has been established by tests in accordance with this Section, mortars using the cementitious materials set forth in Table No. 24-B shall be assumed to meet the strength classification shown when mixed with aggregate in the proportion required by this Section.

The volume of aggregate in mortar shall be at least two times but not more than three times the sum of the separate volumes of cementitious materials or the amounts set forth in Table No. 24-B.

(c) **Gypsum Mortar.** Gypsum mortar shall be composed by weight of one part of gypsum and not more than three parts of mortar aggregate.

(d) **Grout.** Grout shall be Type A-1 or A-2 mortar to which is added water to produce consistency for pouring without segregation of consituents of the mortar.

In grout spaces in brick masonry more than two inches (2") in horizontal dimension and in grout spaces in

TABLE NO. 24-B—MORTAR PROPORTIONS OF CEMENTITIOUS MATERIALS
(by volume)

Mortar and Grout (Cont'd.)

TYPE	MINIMUM PORTLAND CEMENT	MAXIMUM HYDRATED LIME OR LIME PUTTY	MASONRY CEMENT Type II	MAXIMUM DRY LOOSE AGGREGATE
Type A-1	1 part	¼ part	.....	3 parts
Type A-2	1 part	½ part	.....	4½ pts.
Type B	1 part	1 part	.....	6 parts
Type B	.....	.....	1 part	3 parts

TABLE NO. 24-C—MINIMUM THICKNESS OF MASONRY WALLS

TYPE OF MASONRY	MAXIMUM RATIO UNSUPPORTED HEIGHT OR LENGTH TO THICKNESS	NOMINAL MINIMUM THICKNESS (Inches)
Plain Solid Masonry	20	8
Grouted Brick Masonry	22	7
Reinforced Brick Masonry	25	7
Hollow Unit Masonry	18	8
Cavity Wall Masonry	12	8
Stone Masonry (Ashlar)	14	12
Interior Non-Bearing	48	2

TABLE NO. 24-D—ALLOWABLE SHEAR ON BOLTS

DIAMETER OF BOLT (Inches)	EMBEDMENT (Inches)	SHEAR IN POUNDS	
		PLAIN MASONRY	GROUTED MASONRY
½	4	350	550
⅝	4	500	750
¾	5	750	1100
⅞	6	1000	1500
1	7	1250	1850*
1-⅛	8	1500	2250*

*Permitted only with not less than 2500 p.s.i. units.

filled-cell construction more than four inches (4") in both horizontal dimensions, the grout may contain an addition of pea gravel equal to not more than two parts by volume of cement used. Such pea gravel shall be graded with not more than 5 per cent passing the No. 8 sieve and with 100 per cent passing the three-eighths inch (⅜") sieve.

(e) **Footings and Foundations.** Masonry units used in foundation walls and footings shall be laid up in Type A-1 or A-2 mortar.

Sec. 2404. (a) General. The thickness of masonry walls shall be sufficient at all points to withstand all vertical and horizontal loads as specified in Chapter 23, but in no case shall such thickness be less than that set forth in Table No. 24-C; nor shall the ratio of unsupported height or length of the wall (whichever is the lesser) to thickness, be

General Requirements for Masonry Construction

General Requirements for Masonry Construction (Cont'd.)

greater than that set forth in Table No. 24-C, except as specified in Subsection (b).

(b) **Bearing Walls.** The minimum thickness of bearing walls of plain masonry which have not been designed as specified in Section 2404 (a) shall be twelve inches (12") for the upper-most thirty-five feet (35') of their height and shall be increased four inches (4") in thickness for each successive thirty-five feet (35') or fraction thereof measured downward from the top of the wall.

EXCEPTIONS: 1. The top story walls of a building not exceeding three stories or thirty-five feet (35') in height or the walls of a one-story building may have a wall thickness equal to the least dimensions as set forth in Table No. 24-C.

2. The thickness of unreinforced grouted brick masonry walls may be two inches (2") less than required by this subsection but in no case less than as set forth in Table No. 24-C.

3. In residence buildings not more than three stories in height, masonry walls may be of eight inches (8") nominal thickness when not over thirty-five feet (35') in height. Such walls in one-story single-family dwellings, and one-story private garages, may be of six inches (6") nominal thickness when not over nine feet (9') in height, provided that when gable construction is used, an additional six feet (6') is permitted to the peak of the gable.

This exception shall not apply to stone masonry.

(c) **Non-Bearing Walls and Partitions.** Wire mesh may be used to resist tensile stresses when embedded in plaster applied to the surface of the wall. Plaster shall be as specified in Chapter 47.

(d) **Change in Thickness.** When a change in thickness due to minimum thickness requirements occurs between floor levels the greater thickness shall be carried to the higher floor level.

(e) **Chases.** Chases in masonry walls shall not be deeper than one-third the wall thickness nor longer than four feet (4') horizontally and shall have at least eight inches (8") of masonry in back of the chases and between chases and jambs of openings, provided that in dwellings not over two stories high, chases not over four inches (4") deep, thirty inches (30") wide and twenty-four inches (24") high, may be built in eight-inch (8") walls, and provided that chases below windows may equal the width of the opening above. The back and sides of such chases in exterior walls shall be made water resistant and insulated.

(f) **Supported Members.** When unprotected steel or combustible structural members frame into walls of thickness not greater than twelve inches (12"), they shall have not less than four inches (4") of fire-resistive materials on all sides and ends.

Beams, joists, girders or other concentrated loads supported by a wall or pier shall have bearing at least three inches (3") in length upon solid masonry not less than four inches (4") thick or upon a metal bearing plate of ade-

General Requirements for Masonry Construction (Cont'd.)

quate design and dimensions to distribute the loads safely on the wall or pier, or upon a continuous reinforced masonry member projecting not less than three inches (3") from the face of the wall.

(g) **Support.** No masonry shall be supported on combustible construction.

(h) **Anchorage.** Masonry walls that meet or intersect shall be securely bonded or anchored.

Wood joists or wood beams shall be securely anchored to masonry walls at intervals not exceeding four feet (4'), by metal anchors having a minimum cross section of twenty-five hundredths of a square inch (0.25 sq. in.) and at least sixteen inches (16") long, securely fastened to the joists or beams at one end of the anchor by means of a single bolt or other approved method, and the other end of the anchor in the form of a T securely built into the masonry not less than three and one-half inches (3½") with the T vertical.

Where joists run parallel to walls said anchors shall be carried beyond the third joist and shall be solid bridged to the wall. The ends of all wooden beams or joists entering masonry walls shall be cut to a bevel of at least three inches (3").

Structural members framing into or supported by walls or columns shall be adequately anchored.

(i) **Piers.** The height of isolated piers shall not exceed 10 times their least lateral dimension. Every pier whose width is less than three times its thickness shall be designed and constructed as required for columns if such pier is a structural member.

(j) **Openings.** The masonry above openings shall be supported by well buttressed arches or adequately anchored lintels of metal, reinforced masonry, or reinforced concrete, which shall have a minimum bearing of four inches (4"). Timber centering for arches may remain in place provided the opening is not over four feet (4') wide and the timber at each end bears on the wall for a distance not exceeding two inches (2").

(k) **Bolts.** Bolts which are embedded in masonry shall be grouted in place and the connection shall be designed so that the shear on every bolt is not more than the values set forth in Table No. 24-D.

Plain Solid Masonry

Sec. 2405. (a) **General.** Plain solid masonry is that form of construction made with brick, solid load-bearing concrete masonry units, or stone in which the units are all laid and set in mortar placed with a trowel.

(b) **Construction.** Plain solid masonry shall be laid with full header courses at least every sixth course or sixteen inches (16") clear vertically, or there shall be at least one full header in every seventy-two square inches (72 sq. in.) of wall surface. Brick shall be laid with full shoved mortar joints and all head, bed, and wall joints shall be solidly filled with mortar. At the time of laying, clay or shale units shall be clean, damp, and shall have sufficient moisture content so that the amount of water per square inch absorbed during the absorption test is not more than 0.025 ounce.

Plain Solid Masonry (Cont'd.)

During the absorption test the surface of the unit shall be held one-eighth inch (⅛") below the surface for a period of one minute.

(c) **Corbeling.** Corbels may be built only into solid masonry walls twelve inches (12") or more in thickness. The projection for each course in such corbel shall not exceed one inch (1") and the maximum projection shall not exceed one-third the total thickness of the wall when used to support structural members and not more than six inches (6") when used to support a chimney built into the wall. The top course of all corbels shall be a header course.

(d) **Allowable Stresses.** The maximum allowable working unit stresses in plain solid masonry shall not exceed the values set forth in Table No. 24-E except as provided in Chapter 23.

Grouted Brick Masonry

Sec. 2406. (a) **General.** Grouted brick masonry is that form of construction made with brick in which interior joints of the masonry are filled by pouring grout therein as the work progresses.

(b) **Construction.** All brick in the outer tiers shall be laid with full head and bed joints of Type A-1 or A-2 mortar and all interior joints shall be filled with grout. Brick in the interior tiers shall be placed or floated in grout poured between the two outer tiers. One of the outer tiers may be carried up not more than three courses before grouting but the other shall be carried up not more than one course above the grout. Each pour of grout shall be stopped at least one and one-half inches (1½") below the top and properly stirred. The longitudinal vertical joints shall be not less than three-fourths inch (¾") wide. Head or end joints shall be not less than one-half inch (½") wide. Bonding headers shall not be used.

(c) **Allowable Stresses.** The allowable unit working stresses in grouted brick masonry shall not exceed the values set forth in Table No. 24-E, except as provided in Chapter 23.

Reinforced Brick Masonry

Sec. 2407. (a) **General.** The compressive strength of masonry, f'_m, shall be determined by tests on masonry prisms or may be assumed to be 60 per cent of the compressive strength of the brick used with grout and Type A-1 mortar, or 45 per cent of the compressive strength of the brick used with grout and Type A-2 mortar, but such assumed compressive strength of reinforced masonry (f'_m) shall not exceed a value of 2,000 pounds per square inch or 1,500 pounds per square inch respectively, except that grout shall be of Type A-1 mortar.

Tests made to determine the strength f'_m shall be made on not less than five prisms built of the material called for by design, cured in moist atmosphere for 15 days and then allowed to dry at least 30 days before testing. Tests shall be made in accordance with the procedure required for testing concrete cylinders. The prisms for beams and slabs shall be approximately eight by eight by twenty-five inches (8"x8"x25"), built in a horizontal position with unselected

TABLE NO. 24-E—WORKING STRESSES IN UNREINFORCED MASONRY

MATERIAL Grade of Unit	WORKING STRESSES LB. PER SQUARE INCH GROSS AREA								
	TYPE A-1 MORTAR			TYPE A-2 MORTAR			TYPE B MORTAR		
	Compression	Tension in Flexure	Shear	Compression	Tension in Flexure	Shear	Compression	Tension in Flexure	Shear
Plain Solid Brick Masonry									
4500 lb. p.s.i.	250	20	20	225	15	15	200	15	15
2500 lb. p.s.i.	175	20	20	160	15	15	140	15	15
1500 lb. p.s.i.	125	20	20	115	15	15	100	15	15
Grouted Brick Masonry									
4500 lb. p.s.i.	350	25	25	275	20	20	—	—	—
2500 lb. p.s.i.	275	25	25	215	20	20	—	—	—
1500 lb. p.s.i.	225	25	25	175	20	20	—	—	—
Concrete Units—Solid									
Type A	175	12	12	150	12	12	125	12	12
Type B	125	12	12	115	12	12	100	12	12
Hollow Unit Masonry	85	12*	12*	75	10*	10*	70	10*	10*
Cavity Wall Masonry									
Solid Units	125*	12*	12*	115*	10*	10*	100*	10*	10*
Hollow Units	60*	12*	12*	55*	10*	10*	50*	10*	10*
Stone Masonry									
Cast Stone	400	12	12	350	12	12	320	12	12
Natural Stone	125	8	8	125	8	8	125	8	8
Gypsum Masonry	20	—	—	20	—	—	20	—	—

*Net Area

Reinforced Brick Masonry (Cont'd.)

TABLE NO. 24-F—WORKING STRESS IN REINFORCED BRICK MASONRY

TYPE OF STRESS	FOR ANY STRENGTH OF BRICK MASONRY f'_m (Pounds per Square Inch) [SEE SECTION 2407 (a)]
Compression—Axial	0.18 f'_m
Compression—Flexural	0.33 f'_m
Shear—No shear reinforcement	.02 f'_m*
With properly designed shear reinforcement taking ⅔ of entire shear	.04 f'_m*
Bearing	0.25 f'_m
Modulus of Elasticity	1000 f'_m
Modulus of Rigidity	400 f'_m
Bond Type A-1 Grout	
Plain Bars	80
Deformed Bars	130

*1500 f'_m maximum.

brick laid as stretchers in running bond, two bricks wide and three courses high, with one-half-inch (½") joints. Prisms representing walls shall be approximately eight by sixteen inches (8"x16") in plan and sixteen inches (16") high. Those representing columns and pedestals shall be approximately eight by eight inches (8"x8") in plan and sixteen inches (16") high. The bonding arrangement of the brick shall be similar to that in the structures represented. The compressive f'_m value shall be the average value of all prisms tested.

Reinforcement shall conform to the requirements of Section 2604.

(b) **Construction.** Only grouted brick masonry shall be used and such masonry shall conform to all of the construction requirements specified in Section 2406 (b), except that grout shall be Type A-1 mortar.

The thickness of grout or mortar between brick and steel shall be not less than one-fourth-inch (¼"), except that one-fourth-inch (¼") bars may be laid in one-half-inch (½") horizontal mortar joints. Vertical reinforcing shall be accurately placed and held in position before brickwork is started. Horizontal reinforcement may be placed as the brickwork progresses.

In addition to the minimum required reinforcement, at least one one-half-inch (½") bar or equivalent shall be placed on all sides of every opening which exceeds twenty-four inches (24") in either dimension. The bars shall extend twenty-four inches (24") beyond the corners of the opening.

(c) **Design.** The design of reinforced brick masonry shall be based on the assumptions, limitations, and methods of stress determination specified for reinforced concrete in Chapter 26 and shall conform to the additional requirements of this Chapter.

In reinforced masonry walls, the minimum area of reinforcement shall be not less than 0.002 times the cross-

sectional area of the wall, not more than two-thirds of which may be used in either direction. A lesser amount of reinforcement may be used to resist tensile stresses if the masonry is designed under limitations and stresses specified for unreinforced masonry. No required vertical reinforcement shall be less than three-eighths inch (⅜") in diameter. The required horizontal reinforcement may be concentrated in bond beams and at the tops and bottoms of walls and openings with not more than 50 per cent in the tops of footing walls. **Reinforced Brick Masonry (Cont'd.)**

(d) **Stresses.** The allowable unit working stresses in reinforced brick masonry shall not exceed the values set forth in Table No. 24-F, except as provided in Chapter 23.

Sec. 2408. (a) General. Hollow unit masonry is that type of construction made with structural clay tile or hollow concrete masonry units in which the units are all laid and set in mortar. Types A-1, A-2 or B mortar shall be used in such construction except that interior non-bearing masonry of hollow units may be laid up in gypsum mortar. **Hollow Unit Masonry**

(b) **Construction.** Hollow masonry units shall have full mortar coverage of the face shells in both horizontal and vertical joints. Where two or more hollow units are used to make up the thickness of the wall, the stretcher courses shall be bonded at vertical intervals not exceeding thirty-four inches (34") by lapping at least three and three-fourths inches (3¾") over the unit below, or by lapping with units at least 50 per cent greater in thickness than the units below at vertical intervals not exceeding seventeen inches (17"). Where walls of hollow masonry units are decreased in thickness a course of solid masonry not less than four inches (4") in height shall be interposed between the wall section below such point and that next above, or special units or construction shall be used to transmit adequately the loads from the shells above to those below.

(c) **Stresses.** The allowable unit working stresses in hollow unit masonry shall not exceed the values set forth in Table No. 24-E or as provided in this Section, except as provided in Chapter 23.

(d) **Reinforced Filled Cell Construction.** In walls of hollow unit masonry, structural members may be built by filling continuous cores or spaces with concrete or grout in which reinforcement is embedded. Such members may be designed as specified for reinforced brick masonry in Section 2407. The area of such core walls in contact with the fill, and of the face shells of units containing such cores not exceeding the length of one unit, may be included in the computation of the effective areas of the section and the required horizontal reinforcement may be concentrated in bond beams and at the tops and bottoms of walls and openings with not more than 50 per cent in the tops of footing walls. In such walls the required horizontal steel may be concentrated in bond beams and at the tops and bottoms of walls and openings. The minimum steel required shall be calculated on the gross area of the wall.

The value of f'_m may be assumed as provided in Section 2407 (a), applying the designated percentages to the net

Hollow Unit Masonry (Cont'd.)

compressive strength of the units. The value of f'_m may be determined by tests as provided in Section 2407 (a) based on specimens of the dimensions specified for beams and slabs, which may be built of units in the form of hollow squares laid with the mortar and filled with the concrete or grout on which the design is based.

Cavity Wall Masonry

Sec. 2409. (a) **General.** Cavity wall masonry is that type of construction made with brick, structural clay tile or hollow concrete masonry units or any combination of such units in which facing and backing are completely separated except for the metal ties which serve as bonding. Type A-1, A-2, or B mortar shall be used in cavity wall masonry except that Type A-1 mortar shall be used in cavity walls having a nominal thickness of eight inches (8").

Cavity walls eight inches (8") in net thickness shall not exceed twenty-five feet (25') in height, and in no case shall any cavity wall exceed thirty-five feet (35') in height.

(b) **Construction.** In cavity walls neither the facing nor the backing shall be less than three and one-half inches (3½") in net thickness and the cavity shall be not less than one inch (1") net nor more than three inches (3") in width. The facing and backing of cavity walls shall be securely tied together with suitable non-corrosive bonding ties of adequate strength. There shall be at least one three-sixteenths inch (3/16") diameter steel rod or equivalent metal tie for each three square feet (3 sq. ft.) of wall surface placed in the horizontal mortar joints of the facing and backing. Where hollow masonry units are laid with cells vertical, rectangular ties shall be used. The ends of ties shall be bent to 90-degree angles to provide hooks not less than two inches (2") long. Additional bonding ties shall be placed around the perimeter of all openings and shall be spaced not more than three feet (3') apart and within one foot (1') of the openings.

(c) **Stresses.** The allowable unit working stresses in cavity wall construction shall not exceed the values set forth in Table No. 24-E except as provided in Chapter 23.

Stone Masonry

Sec. 2410. (a) **General.** Stone masonry is that form of construction made with natural or cast stone in which the units are laid and set in mortar, with all joints thoroughly filled.

Walls of rubble stone masonry shall be at least four inches (4") greater in thickness than specified for ashlar stone masonry in Section 2404.

(b) **Construction.** All ashlar stone masonry shall be so laid that there is at least one bond stone extending through the wall for every five stretchers. Such bond stones shall be uniformly distributed throughout the wall.

(c) **Stresses.** The allowable unit working stresses in ashlar stone masonry shall not exceed the values set forth in Table No. 24-E, except as provided in Chapter 23.

Gypsum Masonry

Sec. 2411. (a) **General.** Gypsum masonry is that form of construction made with gypsum block or tile in which the units are laid and set in gypsum mortar. Gypsum masonry shall not be used in any bearing wall or where exposed di-

Gypsum Masonry (Cont'd.)

TABLE NO. 24-G—MINIMUM ULTIMATE COMPRESSIVE STRENGTH
Reinforced Gypsum

CLASS	MIXTURE	COMPRESSIVE STRENGTH (Pounds per Sq. In.)
1	Neat (gypsum and water only)	1800
2	Not more than 3 per cent by weight of wood chips, shavings or fiber	1000
3	Not more than 12½ per cent by weight of wood chips, shavings or fiber	500

TABLE NO. 24-H—WORKING STRESSES
Reinforced Gypsum

TYPE OF STRESS	WORKING STRESS (Pounds Per Sq. In.)		
	Class 1	Class 2	Class 3
Compression—flexural	350	220	125
Compression—bearing	200	165	100
Bond and Shear	36	20	10
Modulus of Elasticity	1,000,000	600,000	200,000

Note: Reinforced anchored or electrically welded wire mesh reinforcement shall be considered as meeting the bond and shear requirements of this Section.

rectly to the weather or where subject to frequent or continuous wetting.

(b) **Construction.** All units in gypsum masonry shall be placed in side construction with cells horizontal and the bonding of units in such masonry shall comply with the requirements for bonding of hollow unit masonry as specified in Section 2408 (b). The entire bearing surface of every unit shall be covered with mortar spread in an even layer and all joints shall be filled with mortar.

(c) **Stresses.** The allowable unit working stresses in gypsum masonry shall not exceed the values set forth in Table No. 24-E except as provided in Chapter 23.

Reinforced Gypsum

Sec. 2412. (a) General. Reinforced gypsum shall consist of a mixture of gypsum with or without wood chips, shavings or fiber or other approved aggregates, premixed at the mill, with only water added at the job. Reinforced gypsum shall not be used in any bearing wall or where exposed directly to the weather or where subject to frequent or continuous wetting.

Precast reinforced gypsum shall contain not more than three per cent, and cast-in-place reinforced gypsum not more than 12½ per cent of wood chips, shavings or fiber

Reinforced Gypsum (Cont'd.)

measured as a percentage by weight of the dry mix.

Reinforced gypsum shall develop the minimum ultimate compressive strength in pounds per square inch set forth in Table No. 24-G when dried to constant weight, with tests made on cylinders six inches (6") in diameter and twelve inches (12") long.

Tests, when required, shall follow the procedure specified in U.B.C. Standard No. 24-20.

(b) **Design.** Except as hereinafter provided, methods of design admitting of rational analysis according to established principles of mechanics shall be used. The general assumptions and principles established for reinforced concrete shall also apply to reinforced gypsum insofar as they are pertinent.

For precast floor and roof slabs which cannot be analyzed in accordance with established principles of mechanics, the safe load, uniformly distributed, shall be taken as one-fifth of the total load causing failure in a full-size test panel with the load applied along two lines each distant one-fourth of the clear span from the support.

The minimum thickness of reinforced gypsum in floors and roofs shall be two inches (2") except in the suspension system, which shall be not less than three inches (3"). Hollow precast reinforced gypsum units for roof construction shall be not less than three inches (3") thick and the shell not less than one-half inch (½") thick.

Precast gypsum units for floor and roof construction shall be reinforced and, unless the shape or marking of the unit is such as to insure its being placed right side up, the reinforcement shall be placed symmetrically so that the unit can support its load either side up.

In floor or roof slabs of the suspension type, the reinforcement shall consist of wires with continuity through multiple spans and anchored at the ends. The wires shall be supported in the top of the slab by the roof or floor beams and shall be tightly drawn down as near to the bottom of the slab at mid-span as fire protection requirements will allow, but not closer than one-half inch (½"). Provisions shall be made in the framing of the end bays of this system for resisting the forces due to end anchorage of the wires. The wires shall be designed for a tension in pounds per foot width of slab equal to:

$$\frac{wL^2}{8d}$$

WHERE

w=the total load in pounds per square foot.
L=the clear span in feet.
d=the sag of the wires in feet.

(c) **Stresses.** The working stresses in reinforced gypsum shall not exceed the values set forth in Table No. 24-H except as provided in Chapter 23.

(d) **Anchor Bolts.** The shear on anchor bolts and dowels embedded in Class 3 gypsum shall not exceed the values specified in Table No. 24-I.

TABLE NO. 24-I—SHEAR ON ANCHOR BOLTS AND DOWELS

BOLT or DOWEL SIZE (inches)	EMBEDMENT (inches)	SHEAR (pounds)
⅜ bolt	4	250
½ bolt	4	350
⅝ bolt	4	500
¼ plain dowel	6	200
⅜ deformed dowel	6	250
½ deformed dowel	6	350

Glass Masonry

Sec. 2413. (a) General. Masonry of glass blocks may be used in any non-bearing wall if designed and constructed in conformity with this Section.

(b) Horizontal Forces. The block shall be restrained laterally by an approved mechanical device capable of resisting the horizontal forces specified in Section 2312 for bearing walls.

(c) **Maximum Size of Panels.** No panel of glass block masonry shall exceed thirteen feet (13') in any dimension or one hundred forty-four square feet (144 sq. ft.) in area.

(d) **Expansion Joints.** Every glass block panel shall be provided with one-half-inch (½") expansion joints between the edges of the panel and the supporting structural members.

Faced Walls

Sec. 2414. (a) Material. Materials used in the backing and facing of faced walls shall conform in all respects to the requirements prescribed for such materials in Section 2402. The facing shall be not less than two inches (2") net thickness, and in no case less in thickness than one-eighth the height of the unit.

(b) Allowable Stresses. The stresses in faced walls shall not exceed the allowable stress for the weakest of the combinations of units and mortars of which the wall is composed. Where bonded to the backing as specified in Section 2405 (b), the full cross section of both the facing and the backing may be considered in computing the stresses.

(c) Thickness. Faced walls shall be not less in thickness than is required for masonry walls of the weakest of the combinations of units and mortars of which the wall is composed. Where bonded to the backing as specified in Section 2405 (b), the facing may be considered a part of the wall thickness.

(d) Bond. Ashlar facing of either natural or cast stone shall have at least 20 per cent of the superficial area extending not less than three and three-fourths inches (3¾") into the backing to form bond stones, which shall be uniformly distributed throughout the wall.

Every projecting stone, and, except when alternate courses are full bond courses, every stone not a bond stone, shall be securely anchored to the backing with substantial noncorrodible metal anchors with a cross section of not less

Faced Walls (Cont'd.)

than two-tenths of a square inch (0.2 sq. in.). There shall be at least one anchor to each stone and not less than two anchors for each stone more than two feet (2') in length and three square feet (3 sq. ft.) in superficial area. Facing stones not over twelve square feet (12 sq. ft.) in area shall have at least one anchor to each four square feet (4 sq. ft.) of superficial face area.

When walls of structural clay tile or hollow concrete masonry units are faced with hollow units, the facing units shall be bonded to the backing as required by Section 2408 (b).

Facing of grouted masonry construction as specified in Section 2406 need be neither bonded nor anchored, provided the bond of grout to facing unit will develop a strength in shear of not less than 50 pounds per square inch.

Unburned Clay Units

Sec. 2415. Masonry of Unburned Clay Units. See Appendix.

CHAPTER 25—WOOD

Quality and Design

Sec. 2501. (a) General. The quality and design of all wood members used for load-supporting purposes in buildings or other structures shall conform to the standards specified in this Chapter.

Such members may be composed of solid sawn lumber, plywood, or glued laminated lumber, or combinations of these which in turn may be joined together by fastenings or by suitable adhesives as provided in this Chapter.

(b) **Workmanship.** All members shall be so framed, anchored, tied, and braced together as to develop the strength and rigidity necessary for the purposes for which they are used.

(c) **Fabrication.** Preparation, fabrication, and installation of wood members, and glues and mechanical devices for the fastening thereof, shall conform throughout to good engineering practices.

(d) **Grade and Species. The species and grade of all wood used for load-bearing purposes shall be shown on the plans filed with the Building Department.**

Sizes

Sec. 2502. (a) Required Size. All wood structural members shall be of sufficient size to carry the dead and required live loads without exceeding the allowable working stresses as hereinafter specified.

(b) **Size Defined. Minimum sizes of lumber members** required by this Code refer to nominal sizes. U.B.C. Standard No. 25-1 dressed sizes shall be accepted as the minimum net sizes conforming to nominal sizes. Computations to determine the required sizes of members shall be based on the net dimensions (actual sizes) and not the nominal sizes. If rough sizes or finish sizes exceeding U.B.C. Standard No. 25-1 dressed sizes are to be used, computations may be predicated upon such actual sizes, provided they are specified on the plans. Nominal sizes may be shown on the plans.

Allowable Unit Stresses

Sec. 2503. (a) Working Stress—General. Stresses in pounds per square inch for normal loading shall not exceed the allowable working stresses, except as hereinafter modified, for the respective species and grades set forth in Table No. 25-A, Table No. 25-B and Table No. 25-J; provided, however, that other stress grades may be approved, and stresses for species and grades not given in the following tables shall be established by the Building Official in accordance with the principles set forth in U.B.C. Standard No. 25-2. Stresses used in Table No. 25-J or stresses that exceed those set forth in Table No. 25-A for the lowest structural grade of any species shall be used only when the higher grade of that species is identified by the grade mark of, or certificate of inspection issued by, a lumber grading or inspection bureau or agency recognized as being competent.

The same working stresses and modifications thereto apply to lumber and glued laminated structural lumber that has been pressure impregnated by an approved process and preservative as to the untreated material.

Allowable Unit Stresses (Cont'd.)

Studding, posts, joists, rafters, planks, beams, stringers, and similar load-bearing members shall be not less in grade than 1100f or No. 2 Douglas fir or Southern pine or comparable grades in other species.

(b) **Duration of Load.** Where a member is to be permanently loaded to the maximum allowable stress, by dead load, or by live load applied continuously or cumulatively for more than 10 years such as from fixed equipment, tanks and warehouse storage, the working stresses used in the design shall not exceed 90 per cent of those permitted in Table No. 25-A for stress-grade lumber and Table No. 25-J for structural glued laminated lumber.

When the duration of the full maximum load does not exceed the following periods, the allowable unit stresses set forth in Table No. 25-A and Table No. 25-J may be increased as follows:

15 per cent for two months' duration, as for snow;
25 per cent for seven days' duration;
33⅓ per cent for wind;
100 per cent for impact.

Allowable unit stresses set forth in Table No. 25-A and Table No. 25-J may be used without regard to impact if the stress induced by impact does not exceed the allowable unit stress for normal loading. The above increases are not cumulative. For combined loading the resulting structural members shall not be smaller than required for the longer duration of loading. These adjustments apply to mechanical fastenings except as otherwise noted. Adjustments for durations of load do not apply to modulus of elasticity.

(c) **Conditions of Exposure.** The allowable stresses in Table No. 25-A and the adjustments thereof apply to lumber used under conditions continuously dry. They apply also to lumber impregnated by an approved process and preservative and to the heartwood of a durable species under dry or other conditions of use.

Where the conditions of the above paragraph are not met or other adequate protective measures are not taken in permanent construction, appropriate modifications of the stresses in Table No. 25-A shall be made by the Building Official.

(d) **Working Stress—Joint Details.** 1. **Compression.** Allowable unit compression stresses perpendicular to grain set forth in Table No. 25-A shall be increased in accordance with the following factors for bearings less than six inches (6″) in length and located three inches (3″) or more from the end of a timber.

Length of bearing (inches)	½	1	1½	2	3	4	6 or more
Factor	1.75	1.38	1.25	1.19	1.13	1.10	1.00

For stress under a washer or small plates the same factor may be taken as for a bearing, the length of which equals the diameter of the washer.

2. **Shear.** Allowable unit stresses for joint details shall

be 150 per cent of the horizontal shear values set forth in Table No. 25-A.

In computing the horizontal shear in eccentric joints the effective depth of the member shall be assumed as its actual depth less the distance from the unloaded edge to the nearest edge of the nearest connector. Where bolts alone are used, subtract the distance from the unloaded edge to the center of the nearest bolt.

(e) Plywood Stresses. Working stresses of Douglas fir plywood shall not exceed the values set forth in Table No. 25-B. Working stresses of plywood other than Douglas fir shall be determined according to the species.

Plywood of Douglas fir shall conform to U.B.C. Standard No. 25-3. Plywood of other species, when used structurally, shall be identified as to veneer grade and glue type by an approved agency and shall meet the performance standards in U.B.C. Standard No. 25-3 for its type.

(f) Structural Glued Laminated Members. The allowable unit stresses for structural glued laminated lumber shall be as set forth in Table No. 25-J.

Structural glued laminated members shall conform to U.B.C. Standard No. 25-21.

The stresses for glued lumber not conforming to the requirements of the preceding paragraphs of this Subsection shall be as set forth in Table No. 25-A.

Sec. 2504. The maximum allowable unit stress in horizontal shear in beams and other members in flexure shall be computed by use of the following formula: **Horizontal Shear**

$$H = \frac{3R}{2bh}$$

WHERE

H = maximum unit horizontal shear, pounds per square inch
b = breadth of beam, inches
h = height of beam, inches
R = reaction, pounds, under the following conditions:

(1) Distribution of load to adjacent beams through flooring or other members shall be considered.
(2) All loads uniform or concentrated, within a distance of the height of the beam from the nearest support shall be neglected.
(3) All concentrated loads located at a distance from the support of one to three times the height of the beam shall be considered as placed at three times the height of the beam from the support.

Horizontal shear for notched members shall be computed in accordance with stress values specified in Section 2519.

Sec. 2505. Columns, including struts and other members in compression parallel to grain, shall be designed structurally as follows: **Columns**

(a) Short Columns. The safe load, in pounds per square inch of net cross-sectional area, for columns and other members stressed in compression parallel to the grain, with a ratio of unsupported length to least dimension l/d not exceeding 11 (short columns), shall not exceed the allowable

TABLE NO. 25-A—ALLOWABLE UNIT STRESSES FOR STRESS-GRADE LUMBER

Normal Loading—See also Section 2503(b),(c)

ABBREVIATIONS: J.&P.: Joists and Planks; B.&S.: Beams and Stringers; P.&T.: Posts and Timbers.

SPECIES AND COMMERCIAL GRADE		ALLOWABLE UNIT STRESSES, POUNDS PER SQ. INCH					Rules under which Graded
		Compression Parallel to Grain (Short Columns L/d= 11 or less)	Compression Perpendicular to Grain	Extreme Fiber in Bending (and Tension Parallel to Grain)	Maximum Horizontal Shear	Modulus of Elasticity	
	SYMBOL:	c or p	q	f	H	E	
CYPRESS, TIDEWATER RED:							
1700 f Grade	J.&P.-B.&S.	1,425	360	1,700	145	1,200,000	U.B.C. Standard No. 25-4
1300 f Grade	J.&P.-B.&S.	1,125		1,300	120		
1450 c Grade	P.&T.	1,450		——	——		
1200 c Grade	P.&T.	1,200		——	——		
DOUGLAS FIR, COAST REGION:							
Dense Select Structural	J.&P.-B.&S.	1,550	455	2,150	145	1,600,000	U.B.C. Standard No. 25-5
Select Structural	J.&P.-B.&S.	1,450	415	1,900	120		
1700 f.—Dense No. 1	J.&P.-B.&S.	1,325	455	1,700	145		
1450 f.—No. 1	J.&P.-B.&S.	1,200	390	1,450	120		
1100 f.—No. 2	J.&P.	1,075	390	1,100	110		
Dense Select Structural	P.&T.	1,550	455	——	——		
Select Structural	P.&T.	1,450	415	——	——		
Dense No. 1	P.&T.	1,400	455	——	——		
No. 1	P.&T.	1,200	390	——	——		
HEMLOCK, EASTERN:							
Select Structural	J.&P.-B.&S.	850	360	1,300	85	1,100,000	U.B.C. Standard No. 25-6
Prime Structural	J.&P.	775		1,200	60		
Common Structural	J.&P.	650		1,100	60		
Utility Structural	J.&P.	600		950	60		
Select Structural	P.&T.	850		——	——		
HEMLOCK, WEST COAST:							
1600 f.—Select Structural	J.&P.	1,100	360	1,600	100	1,400,000	U.B.C. Standard No. 25-7
1450 f.—No. 1	J.&P.-B.&S.	1,075		1,450	100		
1100 f.—No. 2	J.&P.	850		1,100	90		
No. 1 Hemlock Timbers	P.&T.	1,075		——	——		

TABLE NO. 25-A (Continued)

	SYMBOL:	c or p	q	f	H	E	
DOUGLAS FIR, INLAND REGION:							
Select Structural	J.&P.	1,750	455	2,150	145	1,600,000	
Structural	J.&P.	1,400	400	1,900	100	1,500,000	U.B.C. Standard
Common Structural	J.&P.	1,250	380	1,450	95	1,500,000	No. 25-6
Select Structural	P.&T.	1,750	455	——	——	1,600,000	
Structural	P.&T.	1,400	400	——	——	1,500,000	
Common Structural	P.&T.	1,250	380	——	——	1,500,000	
LARCH:							
Select Structural	J.&P.	1,750	455	2,150	145		
Structural	J.&P.	1,450	415	1,900	120		
Common Structural	J.&P.	1,325	390	1,450	120	1,500,000	U.B.C. Standard
Select Structural	P.&T.	1,750	455	——	——		No. 25-9
Structural	P.&T.	1,450	415	——	——		
Common Structural	P.&T.	1,325	390	——	——		
OAK, RED AND WHITE:							
2150 f Grade	J.&P.	1,550		2,150	145		
1900 f Grade	J.&P.-B.&S.	1,375		1,900	145		
1700 f Grade	J.&P.-B.&S.	1,200		1,700	145		
1450 f Grade	J.&P.-B.&S.	1,050	600	1,450	120	1,500,000	U.B.C. Standard
1300 f Grade	B.&S.	950		1,300	120		No. 25-10
1325 c Grade	P.&T.	1,325		——	——		
1200 c Grade	P.&T.	1,200		——	——		
1075 c Grade	P.&T.	1,075		——	——		
PINE, SOUTHERN:							
Dense Select Structural	J.&P.-B.&S.	1,700	455	2,400	120		
Dense Structural	J.&P.-B.&S.	1,400	455	2,000	120		
Dense Structural S.E.&S.	J.&P.-B.&S.	1,300	455	1,800	120		
Dense No. 1 Structural	J.&P.-B.&S.	1,150	455	1,600	120	1,600,000	U.B.C. Standard
No. 1 Dense	J.&P.	1,400	455	1,700	150		No. 25-11
No. 1	J.&P.	1,200	390	1,450	125		
No. 2 Dense	J.&P.	1,025	455	1,250	100		
No. 2	J.&P.	875	390	1,100	85		
Dense Select Structural	P.&T.	1,750	455	——	——		
Dense Structural	P.&T.	1,400	455	——	——		

TABLE NO. 25-A (Continued)

SPECIES AND COMMERCIAL GRADE	SYMBOL:	ALLOWABLE UNIT STRESSES, POUNDS PER SQ. INCH: Compression Parallel to Grain (Short Columns L/d= 11 or less) c or p	Compression Perpendicular to Grain q	Extreme Fiber in Bending (and Tension Parallel to Grain) f	Maximum Horizontal Shear H	Modulus of Elasticity E	Rules under which Graded
PINE, SOUTHERN (Continued):							
Dense Structural S.E.&S.	P.&T.	1,300	455	——	——		
Dense No. 1 Structural	P.&T.	1,150	455	——	——		U.B.C Standard No. 25-11
No. 1 Dense 1400f	J.&P.-B.&S.	1,400	455	1,400	140	1,600,000	
No. 1 1200f	J.&P.-B.&S.	1,200	390	1,200	120		
No. 1 Dense 1400f	P.&T.	1,400	455	1,400	140		
No. 1 1200f	P.&T.	1,200	390	1,200	120		
PINE, SOUTHERN LONGLEAF:							
Select Structural Longleaf	J.&P.-B.&S.	1,750		2,400	120		
Prime Structural Longleaf	J.&P.-B.&S.	1,400		2,000	120		
Merchantable Structural Longleaf	J.&P.-B.&S.	1,300		1,800	120		
Structural S.E.&S. Longleaf	J.&P.-B.&S.	1,300		1,800	120		
No. 1 Structural Longleaf	J.&P.-B.&S.	1,150		1,600	120		
No. 1 Longleaf	J.&P.	1,400		1,700	150		
No. 2 Longleaf	J.&P.	1,025	455	1,250	100	1,6[illegible],000	U.B.C. Standard No. 25-12
Select Structural Longleaf	P.&T.	1,750		——	——		
Prime Structural Longleaf	P.&T.	1,400		——	——		
Merchantable Structural Longleaf	P.&T.	1,300		——	——		
Structural S.E.&S. Longleaf	P.&T.	1,300		——	——		
No. 1 Structural Longleaf	P.&T.	1,150		——	——		
No. 1 Longleaf 1400f	J.&P.-B.&S.	1,400	455	1,400	140		
No. 1 Longleaf 1400f	P.&T.	1,400	455	1,400	140		
REDWOOD:							
Dense Structural	J.&P.-B.&S.	1,450		1,700	110		
Heart Structural	J.&P.-B.&S.	1,100	320	1,300	95	1,200,000	U.B.C. Standard No. 25-13
Dense Structural	P.&T.	1,450		——	——		
Heart Structural	P.&T.	1,100		——	——		

TABLE NO. 25-B—RECOMMENDED WORKING STRESSES FOR PLYWOOD (DOUGLAS FIR)

In bending, tension, and compression (except bearing and 45-degree stresses) consider only those plies with their grain direction parallel to the principal stress

DRY LOCATION

TYPE OF STRESS	Exterior A-A (So2S)	Exterior A-B (So/Sld) Exterior A-C (So1S)	Exterior B-C Exterior Sheathing (C-C) Interior Sheathing (C-D) Exterior Concrete Form (B-B) Interior Concrete Form (B-B)	Interior A-A (So2S) Interior A-B (So/Sld) Interior A-D (So1S) Interior B-D (Sld/1S) *(Apply the following percentages to the stresses for the corresponding Exterior grade.)*
EXTREME FIBER in bending				
Face grain // to span	2188	2000	1875	100%
Face grain ⊥ to span	1875	1875	1875	80%
TENSION				
// to face grain (3-ply only*)	2188	2000	1875	100%**
⊥ to face grain	1875	1875	1875	80%
± 45° to face grain	337	320	310	85%
COMPRESSION				
// to face grain (3-ply only*)	1605	1460	1375	100%**
⊥ to face grain	1375	1375	1375	70%
± 45° to face grain	496	472	460	80%
BEARING (on face)	405	405	405	100%
SHEAR, rolling, in plane of plies:				
// or ⊥ to face grain	79	72	68	75%
± 45° to face grain	105	96	90	75%
SHEAR, in plane ⊥ to plies:				
// or ⊥ to face grain	210	192	180	85%
± 45° to face grain	420	384	360	85%
MODULUS OF ELASTICITY in bending				
Face grain // to span	1,600,000	1,600,000	1,600,000	100%
Face grain ⊥ to span	1,600,000	1,600,000	1,600,000	70%

* For tension or compression, // to grain, in 5-ply or thicker, use values for 3-ply, but in next lower grade.
** For 5 or more plies use 90%.

DAMP OR WET LOCATION

Where moisture content will exceed 16 per cent, decrease by 20 per cent values shown for Dry Location for following properties: Extreme Fiber in Bending, Tension and Compression both parallel and perpendicular to grain and at 45 degrees, and Bearing. (No change in values for shear or modulus of elasticity.)

Only Exterior Type plywood should be used where moisture content will exceed 18 per cent.

Columns (Cont'd.)

unit compression stress parallel to grain for short columns, as set forth in Table No. 25-A, i.e.:

$$\frac{P}{A} = c$$

(b) Intermediate Columns. For columns with a ratio of unsupported length to least dimension greater than 11 (intermediate columns), the following formula shall be used until the reduction in allowable stress equals one-third the stress permitted for short columns:

$$\frac{P}{A} = c\left[1 - \frac{1}{3}\left(\frac{l}{Kd}\right)^4\right]$$

(c) Long Columns. For columns with a ratio of unsupported length to least dimension greater than K, (long columns), the safe unit load shall be determined by the following formula:

$$\frac{P}{A} = \frac{\pi^2 E}{36\left(\frac{l}{d}\right)^2} = \frac{0.274\ E}{\left(\frac{l}{d}\right)^2}$$

WHERE

P = total load in pounds

A = area in square inches of net cross-section

$\frac{P}{A}$ = working stress or maximum load per square inch

c = allowable unit stress in compression parallel to grain for short columns (see Table No. 25-A)

l = unsupported length of column in inches

d = least dimension of column in inches

E = modulus of elasticity

K = the $\frac{l}{d}$ at the point of tangency of the parabolic and Euler curves, at which point

$$\frac{P}{A} = \frac{2c}{3} \qquad K = \frac{\pi}{2}\sqrt{\frac{E}{6c}}$$

Columns shall be limited in maximum length between points of lateral support to $l = 50d$, except for spaced columns as specified in Section 2516.

(d) Round Columns. The safe load on a column of round cross-section shall not exceed that permitted for a square column of the same cross-sectional area.

Combined Stresses

Sec. 2506. Members subject to both axial and bending stresses shall be proportioned in accordance with the following formula:

$$\frac{P/A}{c_1} + \frac{M/S}{f_1} \text{ equals or is less than 1.}$$

WHERE

P = total axial load (in pounds).

A = area (in square inches) of net cross-section.

c_1 = allowable unit axial stress permitted for members acting solely as a column (see Table No. 25-A and Section 2505).

M = total bending moment in inch pounds resulting from load causing flexure.

S = section modulus (in inches cubed) for net cross section.

f_1 = allowable unit fiber stress in bending permitted for member (see Table No. 25-A).

Compression on Inclined Surfaces

Sec. 2507. The unit stress normal to a plane inclined to the fiber of a wood member shall not exceed that determined from the formula:

$$n = \frac{p\,q}{p \sin^2 \theta + q \cos^2 \theta},$$

WHERE

n = allowable unit stress on inclined surface, pounds per square inch.

p = allowable compressive unit stress parallel to grain (see Table No. 25-A).

q = allowable compressive unit stress perpendicular to grain (see Table No. 25-A).

θ = angle between the direction of the load and the direction of the grain in degrees.

Bolted Joints

Sec. 2508. (a) Design of Bolted Joints. Bolted joints wherein bolts are used to resist stresses in wood structures shall be designed in accordance with the principles set forth in U.B.C. Standard No. 25-14, and in addition thereto shall comply with the requirements of this Section.

(b) Safe Loads, Double Shear. Safe loads, in pounds on bolts in seasoned lumber of the following species: cedar, eastern red; cypress, southern; Douglas fir (coast region); larch, western; pine, southern yellow; redwood and tamarack, in joints consisting of three members in which the side members are one-half the thickness of the main member, shall not exceed values set forth in Tables No. 25-C and 25-D.

(c) Loads at Angle to Grain. When a force is applied by means of a bolt at an angle with the fiber of a wood member, the safe load shall be determined in accordance with the formula:

$$n = \frac{p\,q}{p \sin^2 \theta + q \cos^2 \theta},$$

WHERE

n = safe load in pounds on bolt.

p = safe load on bolt parallel to grain as set forth in Table No. 25-C.

q = safe load on bolt perpendicular to grain as set forth in Table No. 25-D.

θ = angle between direction of load and direction of member, in degrees.

Bolted Joints (Cont'd.)

TABLE NO 25-C—HOLDING POWER OF BOLTS
Loads Parallel to Grain (p)

LENGTH OF BOLT IN MAIN MEMBER* (Inches)	DIAMETER OF BOLT (INCHES)						
	½	⅝	¾	⅞	1	1⅛	1¼
2	960	1280	1550	1820	2080		
3	1050	1620	2160	2660	3090		
4	1050	1640	2360	3110	3850		
5	1050	1640	2360	3210	4160	5150	
6		1640	2360	3210	4190	5330	
7		1640	2360	3210	4190	5330	
8		1640	2360	3210	4190	5330	6550
10				3210	4190	5330	6550
12					4190	5330	6550

* This assumes full size lumber, i.e., not dressed sizes. Safe loads on dressed sizes may be obtained by interpolation.

TABLE NO. 25-D—HOLDING POWER OF BOLTS
Loads Perpendicular to Grain (q)

LENGTH OF BOLT IN MAIN MEMBER* (Inches)	DIAMETER OF BOLT (INCHES)						
	½	⅝	¾	⅞	1	1⅛	1¼
2	460	520	570	640	700		
3	690	780	890	960	1050		
4	810	1040	1160	1280	1400		
5	780	1150	1440	1600	1750	1900	
6		1110	1540	1880	2100	2280	
7		1060	1500	1970	2390	2660	
8		980	1440	1940	2460	2940	3273
10				1800	2340	2970	3610
12					2180	2820	3460

* This assumes full size lumber, i.e., not dressed sizes. Safe loads on dressed sizes may be obtained by interpolation.

(d) **Bolts in Other Species of Wood.** For species of wood other than those specified in Subsection (b) of this Section, bolt values shall be derived in accordance with the principles stated in U.B.C. Standard No. 25-14.

(e) **Joints Other than Double Shear.** When a joint consists of two members (single shear) of equal thickness, one-half the tabulated load for a piece twice the thickness of one of the members shall be used. When members of a two-member joint are of unequal thickness, one-half the tabulated load for a piece twice the thickness of the thinner member shall be used.

For multiple-member joints other than two or three members, the load for each shear plane shall be computed in the same manner as for a two-member joint.

(f) **Metal Side Plates.** When metal plates are used on each side of a wood member, tabulated bolt values may be increased one-quarter for values parallel to the grain.

Bolted Joints (Cont'd.)

(g) **Joints in Wet Locations.** When the joint is to be used in a location "occasionally wet but quickly dried," tabulated bolt values shall be reduced one-quarter.

In locations "usually wet," tabulated bolt values shall be reduced one-third.

(h) **Definition of Seasoned Lumber.** "Seasoned lumber," for the purpose of this Section, is defined as lumber which has been air-dried for at least 60 days, or which has at the time of installation in the structure reached a moisture content approximately equal to that which it will eventually contain in service.

Where green or recently cut lumber is used, tabulated bolt values shall be reduced one-third.

(i) **Bolt Holes.** Bolt holes in wood members shall be made the same diameter as the bolt, unless otherwise specified on plans. Bolt holes may be specified to be not more than one-sixteenth inch (1/16") larger than the bolt, in which case allowable loads shall be reduced 10 per cent.

(j) **Bolt Hole Spacing.** "Row of Bolts" is defined as a number of bolts placed in a line parallel to the direction of load.

Minimum center-to-center spacing of bolts in any one row for full design loads shall be four times the bolt diameter. In no case shall the bolt bearing capacity of any member be exceeded.

Spacing center-to-center between rows of bolts for loads perpendicular to grain shall be not less than two and one-half times the bolt diameter for an l/d ratio of two, and not less than five times the bolt diameter for l/d ratios of six or more. Intermediate values shall be directly interpolated.

Spacing center-to-center between rows of bolts for loads parallel to grain shall be such that the net tension area remaining at a critical section shall be not less than 80 per cent for softwoods, and 100 per cent for hardwoods, of the total area in bearing under all bolts in the particular timber.

End margin is defined as the distance from the end of a bolted member to the center of the bolt hole nearest the end. This distance, for a member in tension, shall be not less than seven times the bolt diameter for softwoods and five times for hardwoods. End margin, for members in compression, shall be not less than four times the bolt diameter.

Edge margin is defined as the distance from the edge of the timber to the center of the nearest bolt hole. For members loaded perpendicular to grain, edge margin nearest the edge toward which the load is acting shall be at least four times the bolt diameter. For members loaded parallel to grain, edge margin shall be at least one and one-half times the bolt diameter.

Timber Connectors

Sec. 2509. (a) **General.** Timber connectors, bolted in place, may be used to transmit stress between wood members and between wood members and metal members. The allowable loads and installation of timber connectors shall be as specified in U.B.C. Standard No. 25-15.

Safe loads and design practice for types of connectors not mentioned or fully covered by the above publication may be

TABLE NO. 25-E—SAFE LATERAL RESISTANCE OF WOOD SCREWS

In Pounds Per Screw

KIND OF WOOD	GAUGE OF SCREW						
	12	14	16	18	20	22	24
Douglas Fir	159	198	239	287	335	400	460
Redwood	124	155	190	230	272	320	372
Other Species	As determined by the Building Official						

TABLE NO. 25-F—SAFE RESISTANCE OF WOOD SCREWS TO WITHDRAWAL

Inserted Perpendicular to Grain of Wood, in Pounds per Linear Inch of Screw

KIND OF WOOD	GAUGE OF SCREW				
	12	16	20	22	28
Douglas Fir	125	140	150	170	185
Redwood	75	85	90	100	110
Other Species	As determined by the Building Official				

TABLE NO. 25-G—SAFE LATERAL STRENGTH OF COMMON WIRE NAILS

Inserted Perpendicular to the Grain of the Wood, in Pounds Per Nail

KIND OF WOOD	SIZE OF NAIL									
	6d	8d	10d	12d	16d	20d	30d	40d	50d	60d
LENGTH OF NAIL	2″	2½″	3″	3¼″	3½″	4″	4½″	5″	5½″	6″
Douglas Fir or Southern Pine	70	100	120	130	160	190	230	270	310	360
Redwood	58	82	98	106	123	155	188	220	250	295
Other Species	As determined by the Building Official.									

TABLE NO. 25-H—SAFE RESISTANCE TO WITHDRAWAL OF COMMON WIRE NAILS

Inserted Perpendicular to the Grain of the Wood, in Pounds Per Linear Inch of Penetration into the Main Member

KIND OF WOOD	SIZE OF NAIL									
	6d	8d	10d	12d	16d	20d	30d	40d	50d	60d
Douglas Fir or Southern Pine or Redwood	27	29	35	35	39	48	52	56	61	67
Other Species	As determined by the Building Official									

determined from other published recommendations, provided such recommendations are first approved by the Building Official. Allowable load values for timber connectors shall be based on empirical test data. Connector safe load values shall be determined from the combined resistance of the connector and its bolt. **Timber Connectors (Cont'd.)**

(b) **Tension at Net Section.** The unit stress in tension based on the minimum net section through the joint shall not exceed the allowable basic stress for compression parallel to the grain for clear material specified in U.B.C. Standard No. 25-2. The net section shall be the area of the timber with the projected area of the embedded portion of the connection device and that portion of the area of the bolt hole not within the connector projected area deducted.

If knots are permitted to occur at the critical section, the cross-sectional area of the knots outside the area deducted for connectors and bolts shall also be deducted in determining the net section.

Sec. 2510. In connections involving the use of tightly fitting cylindrical pins of iron, steel, heavy steel pipe or hardwood, the allowable load on a pin shall be determined in the same manner as for bolts. **Cylindrical Pins**

Sec. 2511. Connections involving the use of lag screws shall be designed in accordance with the provisions of U.B.C. Standard No. 25-16. **Lag Screws**

Sec. 2512. (a) **Shear Connections.** A wood screw used to fasten a metal plate to a wooden member or a wooden member to a wooden member shall not be subjected to a greater load causing shear and bending than the safe lateral strength of the wood screw as set forth in Table No. 25-E. Screws shall have an embedment into the farther member of at least six-tenths of the length of the screw. The length of the screw shall be not less than seven times the diameter of the screw. **Wood Screws**

(b) **Tension Connections.** A wood screw inserted perpendicular to the grain of the wood shall not be subjected to a greater load tending to cause withdrawal than the safe resistance of the screw to withdrawal as set forth in Table No. 25-F.

A wood screw inserted parallel to the grain of the wood shall not be allowed for resisting computed tensile stresses.

Sec. 2513. (a) **Safe Lateral Strength.** A wire nail inserted perpendicular to the grain of the wood when used to fasten wooden members together, shall not be subjected to a greater load causing shear and bending than the safe lateral strength of the wire nail or spike as set forth in Table No. 25-G. **Nails**

A wire nail inserted parallel to the grain of the wood shall not be subjected to more than three-fourths of the lateral load allowable when inserted perpendicular to the grain.

(b) **Safe Resistance to Withdrawal.** A wire nail inserted perpendicular to the grain of the wood shall not be subjected to a greater load, tending to cause withdrawal, than

Nails (Cont'd.)

the safe resistance of the nail to withdrawal, as set forth in Table No. 25-H.

Nails inserted parallel to the grain of the wood shall not be allowed for resisting computed tensile stresses.

(c) **Spacing and Penetration.** Nails shall not be driven closer together than one-half their length unless driven in bored holes nor closer to the edge of the timber than one-quarter their length. Holes for nails when necessary to prevent splitting, shall be bored of diameter smaller than that of the nails. Nails shall be of such length that, when joining one timber to another, the penetration of the nail into the second or farther timber shall be not less than one-half the length of the nail.

Washers

Sec. 2514. All bolts in direct tension shall be provided with steel plate washers under heads and nuts. The area of these washers must be such that the unit bearing stress on the wood shall not exceed the allowable unit stress. The washer shall be not less in thickness than one-tenth the diameter or the length of the longer side of the washer.

Bolts taking shear only shall have Standard O. G. malleable iron washers, or equivalent, under head and nuts.

Columns or Posts

Sec. 2515. All wood columns and posts shall be framed to true end bearings; shall extend down to supports of such design as to hold securely the column or post in position and to protect its base from deterioration; and shall be supported in basements by footings projecting at least two inches (2") above the finished floor and separated therefrom by a metal plate of not less than one-quarter inch (¼") thickness.

Preservatives shall be applied to column ends where necessary to protect against dampness.

Untreated wood columns in basements, when built into masonry partitions or walls, shall be exposed on at least two sides.

Wood posts, where used as foundations below ground and as piles, (except for minor structures), shall be pressure-treated with an approved preservative.

Built-Up Columns or Compression Members

Sec. 2516. (a) **Built-Up Columns.** The compressive strength of built-up columns or compression members, when composed of two or more members spiked or bolted together, either with or without spacing blocks between members, shall be taken as the combined compressive strength of the individual pieces, each considered as an independent column; provided, however, that compression members which are fastened together by bolts and timber connectors, or otherwise used in such a manner as to approach fixed-end conditions, or which are laterally braced parallel to the least dimension of the individual members, may be calculated as having 80 per cent of the compressive strength of long columns having a slenderness ratio $\frac{l}{d}$ based on the least over-all dimension of the composite member.

(b) **Spaced Columns.** Spaced columns or compression members shall be based upon design principles acceptable to

the Building Official, or the design principles set forth for spaced columns in U.B.C. Standard No. 25-17.

Horizontal Members

Sec. 2517. (a) **End Bearing.** Every beam, girder, and joist shall have end bearing in accordance with compression perpendicular to grain values set forth in Table No. 25-A, but the length of end bearing shall never be less than three inches (3") on masonry or concrete or one and one-half inches (1½") on wood or metal, except that joists when nailed to the adjacent studs may be supported on a one-inch (1") let-in ribbon.

Wood members bearing on or in contact with masonry or concrete at or below adjacent ground level shall be treated with an approved preservative or provided with a moisture-resistant separation over bearing or contact.

(b) **Vertically Laminated Members.** 1. **Beams.** Laminated built-up beams with laminations perpendicular to the plane of the neutral axes shall be considered as having the same resistance to bending moment as solid members of the same size and area, if the laminations are not cut between the ends of the members.

2. **Slabs.** A laminated lumber slab built up of planks set on edge, when meeting the following requirements, may be designed as a solid floor or roof slab of the same thickness, and continuous spans may be designed on the basis of the full cross-section using the simple span moment coefficient:

(1) Planks shall be driven up and spiked closely together with a row of nails near each edge at spaced intervals and staggered vertically. Nail spacing in each row shall not exceed eighteen inches (18") for two-by-eight-inch (2"x8") nominal plank and be proportional for other plank widths. Nail length shall be equal to two and one-half times the net plank thickness.

(2) A single span slab shall have all planks full length.

(3) A continuous slab of two spans shall have not more than each fourth plank spliced between supports.

(4) A continuous slab of more than two spans shall have not more than each third plank spliced between supports.

(5) Joints shall be closely butted over supports or staggered across the slab but within the adjoining quarter-spans. No plank shall be spliced more than twice in any span. (See also Section 3104.)

3. **Other Types.** Types of built-up members not mentioned in this Code may be designed and constructed as recommended in U.B.C. Standard No. 25-18.

(c) **Joist Blocking and Bridging.** Solid blocking of not less than two inches (2") nominal thickness and the full depth of joists shall be provided at the ends of all joists and at each point of support. Solid blocking of two-inch (2") thickness, wood cross bridging of not less than one-inch by four-inches (1"x4") or metal cross bridging of equal strength, shall be placed between lines of bridging, or between bridging and bearing, not exceeding eight feet (8'). The lower ends of the cross bridging shall be driven up and nailed after the sub-floor has been nailed. Roof joists shall be cross bridged

Horizontal Members (Cont'd.)

when the joists exceed a depth of eight inches (8"), and in spans exceeding, and at intervals of, ten feet (10').

EXCEPTION: Solid blocking may be omitted when joists are fastened to a header or laterally supported by joist hangars or nailing to studs.

(d) **Double Joists.** Joists under and parallel to bearing partitions shall be doubled and well spiked or may be separated by solid bridging spaced at not more than four-foot (4') intervals.

(e) **Special Framing.** Header joists over six feet (6') long and tail joists over twelve feet (12') long shall be hung in joist or beam hangers, or secured by other devices affording equivalent support. Trimmers and header joists more than four feet (4') long shall be doubled. Headers shall be not less than twenty inches (20") from face of chimney breast. Trimmers and headers shall be not less than two inches (2") from the flue or chimney.

(f) **Entering Masonry or Concrete.** Wood members entering masonry or concrete walls shall be not less than four inches (4") from other wood members entering from opposite side of wall nor from the exterior face of wall, except on street fronts.

Ends of wood members entering masonry or concrete walls, unless treated with an approved preservative, shall be provided with a one-half-inch (½") air space on sides, top, and end, and shall be beveled so that top edge does not enter masonry or concrete more than one inch (1").

(g) **Anchors and Ties.** Interior wood floor framing above the first floor that abuts or joins masonry or concrete walls shall be securely anchored thereto at not more than four-foot (4') intervals.

Wood in Combination with Masonry or Concrete

Sec. 2518. No structural masonry or concrete shall be supported by wood members except wood piling as specified in Section 2807, except that wood may be combined structurally with masonry or concrete if provision is made for the different rigidities and other properties of the materials.

Cutting and Notching

Sec. 2519. Girders, beams, or joists may be notched or bored in any part of the section within three times the beam depth from either support. Such notches or holes shall not exceed one-fifth of the depth of beam except at point of support and as hereinafter provided.

Where girders, beams, or joists are notched at points of support they shall meet design requirements for net section in bending and also for shear. The shear at such point shall not exceed the value calculated by the following formula:

$$V = \frac{2}{3}\left(\frac{bd^2H}{h}\right)$$

WHERE

V = vertical shear at section under consideration.
b = width of beam.
d = actual depth of beam at the notch.
h = total depth of beam.
H = allowable unit horizontal shear stress.

Where notches or holes are made in other portions of the beam, the net remaining depth of beam shall be used in determining the bending strength.

Deflection

Sec. 2520. Wood members supporting plastered ceilings shall be so proportioned that their deflection under full live load and dead load exclusive of weight of plaster, shall not exceed one three-hundred-and-sixtieth of the span length.

Stud Walls and Partitions

Sec. 2521. (a) **Placing.** Studs in walls and partitions may be placed with the longest dimension parallel with the wall or partition, provided the studs are considered as columns and comply with the column formulas. Such walls shall have top and bottom plates except when framed as provided in Section 2517, first paragraph.

(b) **Plates.** In bearing partitions the top plate shall be doubled and lapped at each intersection with walls or partitions. Joints in the upper and lower members of the top plate shall be staggered not less than four feet (4′).

(c) **Bridging.** All stud partitions or walls over ten feet (10′) in height shall have herringbone bridging, not less than two inches (2″) in thickness and of the same width as the stud, fitted snugly and spiked into the studs at mid-height of stud, or other means for giving equal lateral support to the studs. Herringbone bridging may serve as fire-stopping as required in Section 2522.

(d) **Size and Height.** Exterior stud walls and bearing partitions for buildings of two stories or less shall consist of not less than two-inch by four-inch (2″x4″) studs; for buildings of three stories, the studding shall be not less than three-inch by four-inch (3″x4″) or two-inch by six-inch (2″x6″) to the bottom of the second floor joists and two-inch by four-inch (2″x4″) for the two upper stories. Maximum allowable height of two-inch by four-inch (2″x4″) and three-inch by four-inch (3″x4″) stud framing shall be fourteen feet (14′) and of two-inch by six-inch (2″x6″) stud framing shall be twenty feet (20′) unless the wall is supported laterally by adequate framing. No studding shall be spaced more than sixteen inches (16″) on centers, except that in lieu of this requirement the studs and plates may be designed as a system of columns and beams, provided structural grade material is used, or such walls may be constructed of not less than four-inch by four-inch (4″x4″) posts spaced not more than five feet (5′) on centers or of larger members designed as required in this Chapter, or may be of post and beam framing with plank sheathing not less than one and one-half inches (1½″) thick or may be of laminated construction not less than four inches (4″) nominal in thickness with the structural assembly properly designed to support all loads.

One-story buildings having a total floor area of not more than four hundred square feet (400 sq. ft.) may have exterior walls of vertical one-inch (1″) boards and battens without studs.

(e) **Base Plates.** Stud walls resting on masonry shall have base plates or sills of foundation grade redwood, cedar, cypress or wood treated with approved preservative. Such sills

Stud Walls and Partitions (Cont'd.)

shall be bolted to the masonry at corners and between corners with bolts not less than one-half inch (½") in diameter, embedded not less than seven inches (7") into the masonry and spaced not more than six feet (6') apart, center to center. These sills shall be not less than the width of the studs nor less than two inches (2") thick.

(f) **Corners and Bracing.** Angles at corners where stud walls or partitions meet shall be framed solid so that no lath can extend from one room to another. All exterior and main cross stud partitions shall be effectively and thoroughly braced or sheathed with approved panels adequately nailed along all edges.

(g) **Pipes in Walls.** Stud partitions containing plumbing, heating or other pipes shall be so framed and the joists underneath so spaced as to give proper clearance for the piping. Where a partition containing such piping runs parallel to the floor joists, the joists underneath such partitions shall be doubled and spaced to permit the passage of such pipes and shall be bridged with solid bridging. Where plumbing, heating or other pipes are placed in or partly in a partition, necessitating the cutting of the soles or plates, a metal tie not less than one-eighth inch (⅛") thick and one and one-half inches (1½") wide shall be fastened to the plate across and to each side of the opening with not less than four 16d nails.

(h) **Chimney Space.** Wood lath, furring or framing shall be placed not less than two inches (2") from any chimney and not less than four inches (4") from the back of any fireplace.

(i) **Underpinning.** The underpinning of bearing stud walls shall be so constructed as to resist the design forces.

Underpinning shall be not less in size than the studding above, and when exceeding four feet (4') in height shall be of the size required for an additional story.

No underpinning shall be less than fourteen inches (14") in height. Underpinnings of bearing walls and partitions shall be thoroughly and effectively braced.

(j) **Headers.** All wall openings four feet (4') wide or less shall be provided with double headers not less than two inches (2") thick, placed on edge, securely fastened together, and such headers shall have two-inch (2") solid bearing to the floor or bottom plate. All openings more than four feet (4') wide shall be trussed or provided with lintels which shall have not less than two-inch (2") solid bearing at each end to the floor or bottom plate.

(k) **Interior Partitions.** Interior partitions shall be constructed, framed, and firestopped as specified for exterior walls, except that interior non-bearing partitions may have a single top plate. In Group I occupancies, non-bearing partitions two inch by three inch (2"x3") studs sixteen inches (16") on centers may be used.

All wood frame walls covered with plaster, tile, or substitutes, which are subject to water splash shall be protected with 15 pound Asphalt Saturated Felt.

Stud Walls and Partitions (Cont'd.)

(l) **Wall Coverings.** 1. **General.** Exterior walls shall be covered on the outside with the materials and in the manner specified in this Section.

2. **Weatherboarding.** Studs or sheathing shall be covered on the outside face with one layer of building paper as specified in Section 1707. Weatherboarding, when in place, shall have an average thickness of not less than five-eighths inch (⅝") and a minimum thickness of not less than three-eighths inch (⅜"). Such weatherboarding shall be placed over the paper and shall be securely nailed to the studding with not less than two nails to each stud in each piece of such weatherboarding. Horizontal joints in the weatherboarding shall be tongued and grooved or shiplapped joints, or such weatherboarding shall be laid shingle fashion and lapped not less than one-half inch (½"). Siding patterns known as rustic, drop siding or shiplap shall have an average thickness in place of not less than nineteen thirty-seconds inch (19/32") and a minimum thickness of not less than three-eighths inch (⅜"). Bevel siding shall have a minimum thickness measured at the butt section of not less than seven-sixteenths inch (7/16") and a tip thickness of not less than three-sixteenths inch (3/16"). Siding of lesser dimensions may be used, provided the outside face of the stud is first covered with sheathing as specified in Sec. 2202.

3. **Plywood.** Where plywood is used for covering the exterior of outside walls it shall be of the exterior type not less than three-eighths inch (⅜") thick. Joints shall be backed solid with nailing pieces not less than two inches (2") wide.

4. **Shingles or Shakes.** Shingles or shakes may be used for exterior wall covering provided the frame of the structure is covered with building paper as specified in Section 1707 (a). The thickness of shingles or shakes between wood nailing boards shall be not less than three-eighths inch (⅜").

5. **Weather-Resistant Metal.** Treated or non-corrosive metal may be used on stud walls without sheathing when approved by the Building Official. Contact between dissimilar metals shall be broken by bituminous compound or building paper. Nailing strips shall be placed in such manner as to permit the metal to be nailed at vertical intervals of not more than four feet (4').

6. **Exterior Plastering.** See Chapter 47.

7. **Masonry Veneer.** See Chapter 29.

Fire Stops

Sec. 2522. Firestopping shall be provided to cut off all concealed draft openings (both vertical and horizontal), and form an effective fire barrier between stories, and between a top story and the roof space. It shall be used in specific locations, as follows:

1. In exterior or interior stud walls, at ceilings and floor levels.
2. In all stud walls and partitions, including furred spaces, so placed that the maximum dimension of any concealed space is not over eight feet (8').
3. In furred masonry walls.
4. Between stair stringers at least once in the middle

portion of each run, at top and bottom, and between studs, along and in line with run of stair adjoining such partition.

5. Around top, bottom, sides and ends of sliding door pockets.
6. In spaces between chimneys and wood framing, loose incombustible materials shall be placed in incombustible supports, or a metal collar tightly fitted to the chimney and nailed to the wood framing may be used.
7. Any other locations not specifically mentioned above, such as holes for pipes, shafting, behind furring strips, and similar places which could afford a passage for flames.

Fire stops when of wood shall be two-inch (2") nominal thickness. If width of opening is such that more than one piece of lumber is necessary, there shall be two thicknesses of one-inch (1") material with joints broken.

Foundation Ventilation

Sec. 2523. The space between bottom of floor joists and the ground of any building (except such space as is occupied by a basement or cellar) shall be provided with a sufficient number of ventilating openings through foundation walls or exterior walls to insure ample ventilation, and such openings shall be covered with a corrosion-resistant wire mesh with openings in such mesh not greater than one-half inch (½") nor less than one-fourth inch (¼") in any dimension. The minimum total area of ventilating openings shall be proportioned on the basis of two square feet (2 sq. ft.) for each twenty-five linear feet (25 lin. ft.) or major fraction thereof of exterior wall. Such openings need not be placed in the front of the building.

Minimum clearance between bottom of floor joists and the ground beneath shall be eighteen inches (18").

Wood Diaphragms

Sec. 2524. (a) **General.** Wood diaphragms may be used to distribute horizontal forces to resisting elements such as walls or partitions, provided the maximum deflection in the plane of the diaphragm, as determined by tests or analogies drawn therefrom, does not exceed the permissible deflection of such wall or partition.

In determining the permissible deflection of walls or partitions, the actual elastic properties of the materials (modulus of elasticity, allowable extreme fiber stresses, etc.) may be determined by tests or other data acceptable to the Building Official, or the assigned values for such properties elsewhere herein provided shall be used.

Connections and anchorage of wood diaphragms to resisting elements shall be provided along all the margins of the diaphragm. Such connections shall be capable of resisting the design loads or forces elsewhere herein prescribed.

(b) **Plywood Diaphragms.** Wood diaphragms sheathed with plywood may be used to resist horizontal forces not exceeding those set forth in Table No. 25-I. Plywood thickness shall not be less than that set forth in Table No. 31-B for corresponding joist spacing and live loads.

All boundary members shall be proportioned and spliced

TABLE NO. 25-I—ALLOWABLE SHEARS* FOR WIND OR SEISMIC LOADINGS ON HORIZONTAL PLYWOOD DIAPHRAGMS

(Pounds per Foot of Width)
For Douglas Fir and Southern Pine Framing
(For other species adjust values accordingly)

PLYWOOD THICKNESS	NAIL SIZE	Width of Framing Member					
		Nail Spacing on All Panel Edges 2⅝" or more			Less than 2⅝" but Not Less than 1⅝"		
		6"	4"	3"	6"	4"	3"
5/16"-3/8"	6d com.	185	280	315	165	250	280
3/8"-1/2"-5/8"	8d com.	265	400	450	240	355	405
1/2"-5/8"	10d com.	320	480	545	285	425	485

*Tabulated shears shall be reduced one-fourth for other than wind or seismic loads.

where necessary to transmit direct stresses. Boundary nail spacing shall not exceed one-half that set forth in Table No. 25-I.

End joints of plywood panels shall be staggered. All panel edges shall be nailed to framing members at least one and five-eighths inches (1⅝") thick. When blocking is omitted, loads shall be determined in accordance with engineering analysis. Panel edges shall bear on the framing members and in general butt along their center lines. Nails shall be placed not less than three-eighths inch (⅜") in from the panel edge, not more than twelve inches (12") apart along intermediate joists, and shall be firmly driven into the framing members.

Durability and Termite Protection

Sec. 2525. (a) **Durability.** No wood, other than heartwood of a durable species or wood treated by an approved preservative to be decay resistant, shall be nearer than six inches (6") to any earth unless separated by concrete at least three inches (3") thick, except untreated wood may be used where entirely below ground-water level or continuously submerged in fresh water and untreated wood may be used in fences and similar well ventilated and accessible non-load-bearing structures where not actually in direct contact with earth.

(b) **Termite Protection.** For additional termite and fungus precautions, see Appendix.

Glued Construction: Definitions

Sec. 2526. Glued Structural Members. Plywood shall mean a built-up board of laminated veneers in which the grain of each piece is at right angles to the one adjacent to it. The veneers shall be united under pressure with a bonding agent.

Glued Laminated Lumber shall mean lumber composed of an assembly of wood laminations bonded with adhesives in which the laminations are too thick to be classed as veneers.

Glued Built-up Members shall mean structural members, the sections of which are composed of combinations

Glued Construction: Definitions (Cont'd.)

of solid lumber, plywood, or glued laminated lumber, in which all parts are bonded together with adhesives.

Structural Glued Laminated Lumber shall mean any member comprising an assembly of laminations of lumber in which the grain of all laminations is approximately parallel longitudinally and in which the laminations are bonded with adhesives.

For members stressed principally in bending, the wide face of the laminations shall be normal to the direction of stress, except as hereinafter provided.

Tests for Glues

Sec. 2527. Structural Gluing. (a) **Joints in Structural Glued Laminated Lumber.** Joint shall mean the contact surfaces between two adjacent pieces of wood glued together. An edge or face joint is parallel to the grain of the wood. An end joint is at right angles to the grain of the wood. A scarf joint is a sloping or bevel joint, where pieces of wood are lapped together.

(b) **Adhesives** (Exclusive of plywood). 1. **General.** Adhesives shall provide an adequate bond, shall subject the wood to no deleterious chemical reactions and shall withstand without deterioration the expected conditions of service.

2. **Quality.** Adhesives shall conform to U.B.C. Standard No. 25-22.

3. **Use.** Type I adhesive may be used only in interior and protected locations where moisture content of the wood will not exceed 15 per cent.

Type II adhesive may be used under any conditions of exposure and shall be used where subjected to high humidity.

4. **Tests.** Where sufficient evidence of the quality of adhesive to be used is not available, the Building Official may require tests to be made as set forth in U.B.C. Standard No. 25-23.

(c) **Fabrication.** Structural gluing shall be done only by a fabricator approved by the Building Official.

Fabrication of Glued Built-up Members

Sec. 2528. (a) **General.** Glued laminated lumber shall be fabricated in accordance with good practice and as set forth in U.B.C. Standard No. 25-25.

All work shall be under the supervision of qualified personnel.

(b) **Laminations.** The individual laminations in structural glued laminated lumber shall be not more than two inches (2") in thickness and all such laminations shall be approximately parallel to the neutral plane of the member.

(c) **Lumber Grade.** The lumber shall be of the grade and species specified at the time of laminating.

(d) **Moisture Content.** The maximum moisture content of the wood at the time of gluing shall not exceed 18 per cent and shall be not less than seven per cent. The range of moisture content of laminations assembled into a

single member shall not exceed five per cent at the time of gluing. **Fabrication of Glued Built-up Members**

(e) **Surfaces.** Surfaces to be glued shall be free from dust, dirt, and grease. Individual laminae shall be machined to a smooth surface and to a uniform thickness with a maximum allowable variation of one-sixty-fourth inch (1/64"). Lumber surfaces shall not be sanded before gluing, except that factory sanded plywood shall not be prohibited.

(f) **Adhesive Application.** Gluing practices shall take into consideration the characteristics and limitations of the specific adhesive used and shall conform to good practices as to preparation of wood surfaces for gluing, control of temperature and moisture content of materials, maintenance of adequate pressures, and compatability of the adhesive with any other wood treatments employed. Mixing, spreading, storage life, pot life, working life and assembly time life shall be in accordance with the recommendations of the manufacturer of the adhesive used.

Sec. 2529. (a) **Design Formulas.** Glued laminated structural members shall be designed by the engineering formulas used for solid sawn members and as otherwise provided. Strength shall be calculated on the net dimension of the wood in the member. **Design in Glued Construction**

(b) **Fastenings.** The methods of design of bolts, connectors and the allowable loads for them when used with glued laminated lumber shall be the same as provided for their use with solid sawn lumber.

Sec. 2530. Stressed skin panels shall be designed in accordance with U.B.C. Standard No. 25-20. **Stressed Skin Panel Design**

Sec. 2531. Fabricators. (a). **Fabricators.** All structural glued laminated lumber shall be fabricated by an approved fabricator. **Fabricators**

(b) **Approvals.** To be eligible for approval the fabricator shall have adequate plants and equipment, qualified personnel and experience in the fabrication of glued structural lumber.

Sec. 2532. (a) **Inspection Agencies.** All structural glued laminated lumber shall be inspected during fabrication by an employee of an approved inspection agency or by an approved inspector. **Inspection**

(b) **Inspectors' Qualifications.** To be eligible for approval as an inspector the agency or the employee thereof shall be examined as to his knowledge and experience in glued laminated construction.

(c) **Certificate of Inspection.** Each structural glued laminated member shall be stamped with an identifying number and shall be accompanied by a certificate of inspection. The certificate of inspection shall include pertinent data such as the grade and species of lumber, the type of glue and such other information as may be required. The certificate of inspection shall bear a signed statement by the inspector that the assembly conforms to U.B.C. Standard No. 25-21. The certificate shall also bear a signed statement by the fabricator that the assembly conforms to U.B.C. Standard No. 25-21.

TABLE NO. 25-J—ALLOWABLE UNIT STRESSES—STRUCTURAL GLUED LAMINATED DOUGLAS FIR, (COAST REGION), AND SOUTHERN PINE LUMBER DRY CONDITIONS OF USE

Allowable unit stresses are for normal conditions of loading, pounds per square inch.

Allowable stress values for dry conditions of use shall be applicable for normal loading when the moisture content in service is less than 15 per cent, as in most covered structures.

COMBINATION NUMBER	SPECIES AND COMMERCIAL GRADE COMBINATION			EXTREME FIBER IN BENDING "f"		TENSION PARALLEL TO GRAIN "t"		COMPRESSION PARALLEL TO GRAIN "c"		HORIZONTAL SHEAR "H"	COMPRESSION PERPENDICULAR TO GRAIN "c ⊥"
	1	2	3	4	5	6	7	8	9	10	11
	Grade of inner laminations	Grade of laminations at top and bottom	Number at top and bottom	From 4 to 14 laminations	15 or more laminations	from 4 to 14 laminations	15 or more laminations	From 4 to 14 laminations	15 or more laminations		
	DOUGLAS FIR										
1	Dense Select Structural	Clear (Dense)*	One	3000	3000	3000	3000	2400	2500	165	455
2	Dense No. 1	Clear (Dense)*	One	3000	3000	2600	3000	2200	2300	165	455
3	Dense Select Structural	Dense Select Structural	All	2800	3000	3000	3000	2400	2500	165	455
4	Select Structural	Clear (Close-Grain)*	One	2800	2800	2800	2800	2200	2200	165	415
5	Select Structural	Select Structural	All	2600	2800	2800	2800	2200	2200	165	415
6	No. 1	Select Structural	1/5 of total	2600	2800	2400	2600	2000	2000	165	415
7	No. 1	Clear (Medium Grain)*	One	2600	2600	2200	2400	1900	2000	165	390
8	Dense No. 1	Dense No. 1	All	2400	2600	2600	3000	2200	2300	165	455
9	No. 1	Dense No. 1	1/14 of total	2400	2600	2200	2400	1900	2000	165	455
10	No. 2	Select Structural	1/5 of total	2200	2600	2400	2600	1900	2000	165	415
11	No. 1	Select Structural	One	2200	2400	2200	2400	1900	2000	165	415
12	No. 2	Clear (Medium Grain)*	One	2200	2200	2000	2400	1800	1900	165	390
13	No. 2	Select Structural	One	2200	2200	2000	2400	1800	1900	165	415
14	No. 1	No. 1	All	2000	2200	2200	2400	1900	2000	165	390
15	No. 2	No. 1	One	2000	2200	2000	2400	1800	1900	165	390
16	No. 2	No. 2	All	—	2000	2000	2400	1800	1900	165	390

TABLE NO. 25-J (Continued)

COMBINATION NUMBER	SPECIES AND COMMERCIAL GRADE COMBINATION			EXTREME FIBER IN BENDING "f"		TENSION PARALLEL TO GRAIN "t"		COMPRESSION PARALLEL TO GRAIN "c"		HORIZONTAL SHEAR "H"	COMPRESSION PERPENDICULAR TO GRAIN "c ⊥"
	1	2	3	4	5	6	7	8	9	10	11
	Grade of inner laminations	Grade of laminations at top and bottom	Number at top and bottom	From 4 to 14 laminations	15 or more laminations	from 4 to 14 laminations	15 or more laminations	From 4 to 14 laminations	15 or more laminations		
SOUTHERN PINE											
1	No. 1 Dense	No. 1 Dense	All	3000	3000	3000	3000	2400	2500	200	450
2	No. 1	B&B Dense	1/14 of total	3000	3000	2600	2600	2100	2100	200	450
3	No. 1	No. 1 Dense	1/14 of total	3000	3000	2600	2600	2100	2100	200	450
4	No. 2 Dense	B&B Dense	One	2800	2800	3000	3000	2400	2400	200	450
5	No. 2 Dense	No. 1 Dense	1/5 of total	2800	3000	2800	3000	2300	2400	200	450
6	No. 1	No. 1	All	2600	2600	2600	2600	2100	2100	200	385
7	No. 2	B&B Dense	1/14 of total	2400	2800	2600	2600	2000	2000	200	450
8	No. 2	B&B	One	2400	2400	2600	2600	2000	2000	200	385
9	No. 2	No. 1	1/5 of total	2400	2600	2400	2600	2000	2000	200	385
10	No. 2 Dense	No. 2 Dense	All	2000	2600	2600	3000	2200	2300	200	450
11	No. 2	No. 2 Dense	1/14 of total	2000	2600	2200	2600	1900	2000	200	450
12	No. 2	No. 2	All	1800	2200	2200	2600	1900	2000	200	385

NOTES: Modulus of elasticity, "E", dry conditions of use, 1,800,000.

Allowable stress values for dry conditions of use shall be applicable for normal loading when the moisture content in service is less than 15 per cent as in most covered structures.

For wet conditions of use, the following maximum percentages of Dry Use Stresses shall be permitted:

"f" (bending) and "t" (tension) 80%

"H" (horizontal shear) and "M" (modulus of elaasticity) 90%

"c" (compression parallel and perpendicular) 70%

*The rate of growth and density requirements of inner laminations shall apply to clear outer laminations.

CHAPTER 26—CONCRETE

Quality

Sec. 2601. The quality of the materials used in concrete and the quality of concrete shall conform to the physical and chemical properties as specified in Sections 2604, 2605, and 2606.

Design

Sec. 2602. The design of reinforced concrete shall conform to the rules and principles specified in this Chapter.

Definitions

Sec. 2603. The following definitions give the meaning of certain terms as used in this Chapter.

Aggregate—Inert material which is mixed with portland cement and water to produce concrete.

Column—An upright compression member the length of which exceeds three times its least lateral dimension.

Concrete—A mixture of portland cement, fine aggregate, coarse aggregate and water.

Deformed Bar—A reinforcing bar conforming to U.B.C. Standard No. 26-14. Bars not conforming to these specifications shall be classed as plain bars. Except as specified in Sec. 2615 wire mesh with welded intersections not farther apart than six inches (6") in the direction of the principal reinforcement and with cross wires not smaller than No. 10 W. & M. gauge may be rated as a deformed bar.

Effective Area of Concrete—The area of a section which lies between the centroid of the tensile reinforcement and the compression face of a flexural member.

Effective Area of Reinforcement—The area obtained by multiplying the right cross-sectional area of the metal reinforcement by the cosine of the angle between its direction and that for which the effectiveness of the reinforcement is to be determined.

Laitance—Extremely fine material of little or no hardness which may collect on the surface of freshly deposited concrete or mortar, resulting from the use of excess mixing water and usually recognized by its relatively light color.

Mortar—A mixture of portland cement, fine aggregate and water.

Negative Reinforcement—Reinforcement so placed as to take tensile stress due to negative bending moment.

Pedestal—An upright compression member whose height does not exceed three times its least lateral dimension.

Plain Concrete—Concrete without metal reinforcement, or reinforced only for shrinkage or temperature changes.

Pneumatically Placed Concrete—A mixture of fine aggregate and cement pneumatically applied by suitable mechanism, and to which water is added immediately prior to discharge from the applicator. It shall be considered as concrete for particulars of design as specified in this Chapter.

Portland Cement—The product obtained by finely pulverizing clinker consisting essentially of hydraulic calcium silicates, to which no additions have been made subsequent to calcination other than water or untreated calcium sulfate,

except that additions not to exceed 1.0 per cent of other materials may be interground with the clinker at the option of the manufacturer, provided such materials in the amounts indicated have been shown to be not harmful by tests. **Definitions (Cont'd.)**

Positive Reinforcement—Reinforcement so placed as to take tensile stress due to positive bending moment.

Ratio of Reinforcement—The ratio of the effective area of the reinforcement cut by a section of a member to the effective area of the concrete at that section.

Reinforced Concrete—Concrete in which metal other than that provided for shrinkage or temperature changes is embedded in such a manner that the two materials act together in resisting forces.

Surface Water—The water carried by the aggregate except that held by absorption within the aggregate particles themselves.

Sec. 2604. (a) **Portland Cement.** Portland cement shall conform to U.B.C. Standard No. 26-1. **Materials**

(b) **Concrete Aggregates.** Concrete aggregates, except lightweight aggregates, shall conform to U.B.C. Standard No. 26-2, including the methods of sampling and testing.

Lightweight aggregates for concrete shall conform to U.B.C. Standard No. 26-3, including the methods of sampling and testing.

Aggregates that do not meet the above specifications but that have been shown by test or actual service to produce concrete of the required strength, durability, watertightness and wearing qualities, may be used under the provisions of Section 2606, Method 2, where authorized by the Building Official.

The maximum size of the aggregate shall be not larger than one-fifth of the narrowest dimension between forms of the member for which the concrete is to be used nor larger than three-fourths of the minimum clear spacing between reinforcing bars.

(c) **Water.** Water used in mixing concrete shall be clean and free from injurious amounts of oil, acid, alkali, organic matter or other harmful substances.

(d) **Metal Reinforcement.** Metal reinforcement shall conform to the requirements of U.B.C. Standard No. 26-4, or U.B.C. Standard No. 26-5, or U.B.C. Standard No. 26-6, or U.B.C. Standard No. 26-7. Deformations on deformed bars shall conform to the requirements of U.B.C. Standard No. 26-14.

All reinforcement bars lacking grade identification marks shall on delivery be accompanied by a manufacturers' guarantee of grade which will identify variations.

(e) **Storage.** Storage of cement and aggregates shall be in a manner to prevent deterioration or the intrusion of foreign matter. Any material which has deteriorated or which has been damaged shall not be used for concrete.

Sec. 2605. On concrete work the Building Official shall have the right to require the owner or his agent to make tests of the concrete and other materials from time to time **Tests**

Tests (Cont'd.)

to determine whether the materials and methods in use are such as to produce concrete or reinforced concrete of the quality specified and used in the design of the building or structure. The tests shall be made, when ordered by the Building Official, by the owner or his authorized representative and no responsibility for the expense of these tests shall attach to the Building Department. All such tests shall be made by an approved agency, and copies of the results shall be kept on file in the office of the Building Official for a period of not less than two years after the acceptance of the structure. Specimens for concrete cylinder tests shall be taken at the place where the concrete is being deposited and shall be taken and cured in accordance with U.B.C. Standard No. 26-8 and tested in accordance with U.B.C. Standard No. 26-9. Test cylinders of pneumatically placed concrete shall be made in a manner that will permit the blast of air to compact firmly the materials and provide proper escapement of the air to eliminate possible back pressure, and such cylinders shall be cured and tested as specified above.

The Building Official shall have the right to order the test under load of any portion of a completed structure, when the conditions have been such as to leave reasonable doubt as to the adequacy of the structure to serve the purpose for which it is intended.

When a load test is required, the member or portion of the structure under consideration shall be subject to a superimposed load equal to one and one-half times the live load plus one-half of the dead load. This load shall be left in position for a period of 24 hours before removal. If, during the test, or upon removal of the load, the member or portion of the structure shows evident failure, such changes or modifications as are necessary to make the structure adequate for the rated capacity shall be made; or, where lawful, a lower rating shall be established. The structure shall be considered to have passed the test if the maximum deflection at the end of the 24-hour period does not exceed the value of D as given by the following:

$$D = \frac{.001\ L^2}{12t} \qquad (1)$$

WHERE

L is the span, t is the total depth of the slab or beam and D is the maximum deflection—all expressed in the same units.

If the deflection exceeds the value of D as given in Formula (1), the construction shall be considered to have passed the test if within 24 hours after the removal of the load the slabs or beams show a recovery of at least 75 per cent of the observed deflection.

Quality of Concrete

Sec. 2606. For the design of concrete structures, the value of f'_c used for determining the working stresses as stipulated in Section 2613 shall be based on the specified minimum ultimate 28-day compressive strength of the concrete, or on the specified minimum ultimate compressive strength at the earlier age at which the concrete may be expected to re-

TABLE NO. 26-A—ASSUMED STRENGTH OF CONCRETE MIXTURES

Quality of Concrete (Cont'd.)

WATER-CONTENT U. S. GALLONS PER 94-LB. SACK OF CEMENT	ASSUMED COMPRESSIVE STRENGTH AT 28 DAYS
U. S. Gallons	Pounds Per Square Inch
7½	2000
6¾	2500
6	3000
5	3750

ceive its full load. All plans submitted for approval or used on the job shall clearly show the assumed strength of concrete at a specified age for which all parts of the structure were designed.

Concrete exposed to the action of freezing weather shall have a water content not greater than six gallons per sack of cement.

The determination of the proportions of cement, aggregate and water to attain the required strengths shall be made by one of the following methods:

Method 1—Concrete made from average materials—When no preliminary tests of the materials to be used are made, the water-content per sack of cement shall not exceed the values set forth in Table No. 26-A. Method 2 shall be employed when artificial aggregates or admixtures are used.

Method 2—Controlled Concrete—Water-contents other than those set forth in Table No. 26-A may be used provided that the strength-quality of the materials proposed for use in the structure shall be established by tests which shall be made in advance of the beginning of operations, using the consistencies suitable for the work and in accordance with U.B.C. Standard No. 26-10 and U.B.C. Standard No. 26-9. A curve representing the relation between the water-content and the average 28-day compressive strength or earlier strength at which the concrete is to receive its full working load, shall be established for a range of values including all the compressive strengths called for on the plans. The curve shall be established by at least three points, each point representing average values from at least four test specimens. The water-content used in the concrete for the structure as determined from the curve, shall correspond to a strength which is 15 per cent greater than that called for on the plans. No substitutions shall be made in the materials used on the work without additional tests in accordance herewith to show that the quality of the concrete is satisfactory.

Sec. 2607. The proportions of aggregate to cement for any concrete shall be such as to produce a mixture which will work readily into the corners and angles of the forms and around reinforcement with the method of placing employed on the work, but without permitting the materials to segregate or excess free water to collect on the surface. **Proportions and Consistency**

Proportions and Consistency (Cont'd.)

The combined aggregates shall be of such composition of sizes that when separated on the No. 4 standard sieve, the weight passing the sieve (fine aggregate) shall be not less than 30 per cent nor greater than 50 per cent of the total unless otherwise required by the Building Official, except that these proportions do not necessarily apply to lightweight aggregates.

Measurement of materials for ready mixed concrete shall conform to U.B.C. Standard No. 26-11.

Admixtures of lime or finely pulverized inert materials may be added but not in excess of six per cent by volume of the cement used.

Control of Proportions

Sec. 2608. The methods of measuring concrete materials shall be such that the proportions of all materials can be accurately controlled during the progress of the work and easily checked at any time by the Building Official or his authorized representative. A tolerance of one-fourth gallon of water per sack of cement in any batch of concrete will be allowed provided that the average for any 10 consecutive batches does not show a water content greater than that set forth in Table No. 26-A, and on plans as specified in Section 2606.

The method of delivering the aggregates to the work and of storing and handling shall be such that the moisture content of the aggregates as they come to the mixer shall not be subject to frequent or unnecessary changes.

Mixing and Placing Concrete

Sec. 2609. (a) **Mixing.** The concrete shall be mixed until there is a uniform distribution of the materials and the mass is uniform in color and homogeneous. In machine mixing, only batch mixers shall be used. Each batch shall be mixed not less than one minute after all the materials are in the mixer and must be discharged completely before the mixer is recharged. Machine mixers shall have a peripheral speed of approximately two hundred feet (200') per minute.

Ready mixed concrete shall be mixed and delivered in accordance with the requirements set forth in U.B.C. Standard No. 26-11.

(b) **Cleaning Forms and Equipment.** Before concrete is placed all equipment for mixing and transporting the concrete shall be cleaned, all debris shall be removed from the spaces to be occupied by the concrete, forms shall be thoroughly wetted (except in freezing weather) or oiled, and masonry that will be in contact with concrete shall be well drenched (except in freezing weather). Reinforcement shall be thoroughly cleaned and secured in position. Concrete shall not be placed until the forms and reinforcement have been inspected and approved by the Building Official.

(c) **Removal of Water From Excavations.** Water shall be removed from excavations before concrete is deposited, unless otherwise directed by the Building Official. Any flow of water into an excavation shall be diverted through proper side drains to a sump, or be removed by other approved methods which will avoid washing the freshly deposited concrete. Water vent pipes and drains shall be filled by grouting or otherwise, after the concrete has hardened thoroughly.

Mixing and Placing Concrete (Cont'd.)

(d) **Transporting Concrete.** Concrete shall be handled from the mixer to the place of final deposit as rapidly as practicable by methods which shall prevent the separation or loss of the ingredients. It shall be deposited as nearly as practicable in its final position to avoid rehandling or flowing. Under no circumstances shall concrete that has attained its initial set be used.

Equipment for chuting, pumping and pneumatically conveying concrete shall be of such size and design as to insure a practically continuous flow of concrete at the delivery end without separation of the materials.

(e) **Placing.** Concrete shall be thoroughly compacted with suitable tools. When necessary, openings shall be provided in the forms to permit the placing of concrete in such a manner as to avoid accumulations of hardened concrete on the forms or reinforcing bars. The concrete shall be thoroughly worked around the reinforcement.

(f) **Curing.** Exposed surfaces of concrete shall be kept moist for a period of at least seven days after being deposited for ordinary cement and three days for high-early-strength cement.

(g) **Depositing in Cold Weather.** Adequate equipment shall be provided for heating the concrete materials and protecting the concrete during freezing or near-freezing weather. No frozen materials or materials containing ice shall be used.

All concrete materials and all reinforcement, forms, fillers and ground with which the concrete is to come in contact, shall be free from frost. Wherever the temperature of the surrounding air is below 40 degrees Fahrenheit, all concrete when placed in the forms shall have a temperature of between 60 and 90 degrees Fahrenheit and shall be maintained at a temperature of not less than 50 degrees Fahrenheit for at least 72 hours for normal concrete or 24 hours for high-early-strength concrete, or for as much more time as is necessary to insure proper rate of curing of the concrete. The housing, covering, or other protection used in connection with curing shall remain in place and intact for at least 24 hours after the artificial heating is discontinued. No dependence shall be placed on salt or other chemicals for the prevention of freezing. Manure, when used for protection, shall not be applied directly to concrete.

(h) **Bonding Fresh and Hardened Concrete.** Before new concrete is deposited on or against concrete which has set, the forms shall be re-tightened, the surface of the set concrete shall be roughened, cleaned of foreign matter and laitance and thoroughly wetted but not saturated. The clean and wetted surfaces of the hardened concrete, including vertical and inclined surfaces, shall be slushed with a coating of neat cement grout against which the new concrete shall be placed before the grout has attained its set. For walls and columns the grout may be omitted on the horizontal surfaces, but a layer of mortar having the composition of the mortar in the concrete shall be placed before resuming concreting.

Forms and Details of Construction

Sec. 2610. (a) Design of Forms. Forms shall conform to the shape, lines and dimensions of the member as called for on the plans and shall be substantial and sufficiently tight to prevent leakage of mortar. They shall be properly braced or tied together so as to maintain position and shape. If adequate foundation for shores cannot be secured, trussed supports shall be provided.

Temporary openings shall be provided at the base of column and wall forms, and at other points where necessary, to facilitate cleaning and inspection.

(b) Removal of Forms. Forms shall not be disturbed until the concrete has hardened sufficiently to permit their removal with safety. Shoring shall not be removed until the member has acquired sufficient strength to support safely its own weight and the load upon it. Members subject to additional loads during construction shall be adequately shored to support both the member and construction loads in a manner that will protect the member from damage.

The Building Official may require forms to remain in place for a specified time.

(c) Cleaning and Bending Reinforcement. Metal reinforcement, at the time concrete is placed, shall be free from rust, scale or other coatings that will destroy or reduce the bond. Bends for stirrups and ties shall be made around a pin having a diameter not less than two times the minimum thickness of the bar. Bends for other bars, except hooks, shall be made around a pin having a diameter not less than six times the minimum thickness of the bar, except that for bars larger than one inch, the pin shall be not less than eight times the minimum thickness of the bar. All bars shall be bent cold.

(d) Placing Reinforcement. Metal reinforcement shall be accurately placed and secured and shall be supported by chairs, spacers, or hangers. The minimum clear distance between parallel bars, except in columns, shall be equal to the nominal diameter of the bars. The minimum clear distance between bars and forms shall be the diameter of round bars and one-and-one-half times the side dimension of square bars. The clear distance between bars shall be not less than one inch (1") or less than one-and-one-third times the maximum size of the coarse aggregate. Bars shall be embedded a distance from any face of any member not less than the minimum distance as specified in Section 4303.

When wire or other reinforcement not exceeding one-fourth inch (¼") in diameter is used as reinforcement for slabs not exceeding ten feet (10') in span, the reinforcement may be curved from a point near the top of the slab over the support to a point near the bottom of the slab at midspan; provided such reinforcement is either continuous over, or securely anchored to the support.

(e) Splices and Offsets in Reinforcement. In slabs, beams and girders, splices of reinforcement shall not be made at points of maximum stress without the approval of the Building Official. Splices, where permitted, shall provide sufficient lap to transfer the stress between bars by bond and shear. In such splices the bars shall be in contact and wired to-

gether and the minimum distance specified in Subsection (d) of this Section shall be maintained between bars or between wired splices and adjacent bars or splices.

Forms and Details of Construction (Cont'd.)

Where changes in the cross section of a column occur, the longitudinal bars shall be offset in a region where lateral support is afforded. Where offset, the slope of the inclined portion shall not be more than one in six, and in the case of tied columns the ties shall be spaced not over three inches (3″) on centers for a distance of one foot (1′) below the actual point of offset.

(f) **Protective Covering of Concrete.** At the under side of footings metal reinforcement shall have a minimum covering of three inches (3″) of concrete.

In fire-resistive construction, metal reinforcement shall be protected as specified in Section 4303.

Exposed reinforcement bars intended for bonding with future extensions shall be protected from corrosion.

(g) **Construction Joints.** Joints not indicated on the plans shall be so made and located as least to impair the strength of the completed structure. Where a joint is to be made, any excess water and laitance shall be removed from the surface after concrete is deposited. Before depositing of concrete is resumed the hardened surface shall be treated as specified in Section 2609 (h).

At least two hours must elapse after concrete is deposited in the columns or walls before depositing in beams, girders, or slabs supported thereon. Haunches and column capitals shall be considered as part of, and to act continuous with, the floor.

Construction joints in floors shall be located near the middle of the spans of slabs, beams or girders, unless a beam intersects a girder at this point, in which case the joints in the girders shall be offset a distance equal to twice the width of the beam. In this last case, provision shall be made for shear by use of inclined reinforcement.

(h) **Embedment of Pipes.** Pipes which will contain liquid, gas or vapor at other than room temperature shall not be embedded in concrete necessary for structural stability or fire protection. Drain pipes and pipes whose contents will be under pressure greater than asmospheric pressure by more than one pound per square inch shall not be embedded in structural concrete except in passing through from one side to the other of a floor, wall or beam. Electric conduits and other pipes whose embedment is allowed shall not, with their fittings, displace that concrete of a column on which stress is calculated or which is required for fire protection, to greater extent than four per cent of the area of the cross section. Sleeves or other pipes passing through floors, walls or beams shall not be of such size or in such location as unduly to impair the strength of the construction; such sleeves or pipes may be considered as replacing structurally the displaced concrete, provided they are not exposed to rusting or other deterioration, are of uncoated iron or steel not thinner than standard wrought-iron pipe, have a nominal inside diameter not over two inches (2″) and are spaced not less than three diameters on centers. Embedded pipes or conduits other than those merely passing

through shall not be larger in outside diameter than one-third the thickness of the slab, wall or beam in which they are embedded; shall not be spaced closer than three diameters on centers, nor so located as unduly to impair the strength of the construction. Circular uncoated or galvanized electric conduit of iron or steel may be considered as replacing the displaced concrete.

No chase, sleeve or pipe shall intercept a structural member unless such member is specifically designed therefor.

Assumptions for Design

Sec. 2611. The design of reinforced concrete members shall be made with reference to working stresses and safe loads. The accepted theory of flexure as applied to reinforced concrete shall be applied to all members resisting bending. The following assumptions shall be made:

(1) The steel takes all the tensile stress.

(2) In determining the ratio n for design purposes, the modulus of elasticity for the concrete shall be taken as $1000f'_c$, and that for steel as 30,000,000 pounds per square inch.

Symbols and Notations

Sec. 2612. The symbols and notations used in these regulations are defined as follows:

α = Angle between inclined web bars and axis of beam.

A_v = Total area of web reinforcement in tension within a distance of s, or the total area of all bars bent up in any one plane.

b = Width of rectangular section or width of flange of T or I sections.

b' = Width of web of I or T sections.

C = Ratio of permissible concrete fiber stress in axially loaded column to permissible fiber stress in flexure.

d = Depth from compression face of beam or slab to centroid of longitudinal tensile reinforcement.

e = Eccentricity of the resultant load on a column, measured from the gravity axis.

E_c = Modulus of elasticity of concrete in compression.

E_s = Modulus of elasticity of steel in tension or compression (30,000,000 lbs. per sq. in.).

f_c = Compressive unit stress in extreme fiber of concrete in flexure.

f'_c = Ultimate compressive strength of concrete *usually* at age of 28 days. (See Section 2606).

f_v = Tensile unit stress in web reinforcement.

I = Moment of inertia of a section about the neutral axis for bending.

Symbols and Notations (Cont'd.)

j = Ratio of distance between centroid of compression and centroid of tension to the depth (d).

n = Ratio of modulus of elasticity of steel to that of concrete $= \frac{E_s}{E_c}$

Σ_o = Sum of perimeters of bars in one set.

R = Least radius of gyration of a section.

s = Spacing of stirrups or of bent bars in a direction parallel to that of the main reinforcement.

t_1 = Thickness of flat slab without drop panels, or the thickness of flat slab through the drop panels where such are used.

t_2 = Thickness of flat slab (with drop panels) at points outside the drop panel.

u = Bond stress per unit of surface area of bar.

v = Shearing unit stress.

v_c = Unit shearing stress permitted on the concrete of the web.

V = Total shear.

V' = Excess of the total shear over that permitted on the concrete.

w = Uniformly distributed load per unit of length of beam or per unit area of slab.

Allowable Unit Stresses in Reinforcement

Sec. 2613. The unit stresses in pounds per square inch on concrete to be used in the design shall not exceed the values set forth in Table No. 26-B where f'_c equals the minimum ultimate compressive strength at 28 days, or at the earlier age at which the concrete may be expected to receive its full load.

The following unit stresses in reinforcing steel shall not be exceeded:

In Tension:

Intermediate and hard grade billet or axle steel, rail steel and cold drawn wire.....	20,000 p.s.i.
Structural grade bars and structural steel shapes	18,000 p.s.i.
For one-way slabs not exceeding 12 feet in span, steel reinforcement not exceeding ⅜ inch in diameter, 50 per cent of the minimum yield point specified in the U.B.C. Standards for the particular kind and grade of steel used, but in no case to exceed	30,000 p.s.i.

In Compression:

Structural steel section in composite columns	16,000 p.s.i.
Cast-iron section in composite columns.....	10,000 p.s.i.

TABLE NO. 26-B—ALLOWABLE UNIT STRESSES IN CONCRETE

DESCRIPTION		ALLOWABLE UNIT STRESSES					
		For any strength of concrete as fixed by test in accordance with Sec. 2606 $n = 30{,}000/f'_c$	Maximum value, psi	When strength of concrete is fixed by the water content in accordance with Sec. 2606			
				$f'_c = 2000$ psi $n = 15$	$f'_c = 2500$ psi $n = 12$	$f'_c = 3000$ psi $n = 10$	$f'_c = 3750$ psi $n = 8$
Flexure: f_c							
Extreme fiber stress in compression	f_c	$0.45f'_c$		900	1125	1350	1688
Extreme fiber stress in tension in plain concrete footings	f_c	$0.03f'_c$		60	75	90	113
Shear: v (as a measure of diagonal tension)							
Beams with no web reinforcement	v_c	$0.03f'_c$		60	75	90	113
Beams with properly designed web reinforcement	v	$0.12f'_c$		240	300	360	450
*Flat slabs at distance d from edge of column capital or drop panel	v_c	$0.03f'_c$		60	75	90	113
**Footings	v_c	$0.03f'_c$	75	60	75	75	75
Reinforced concrete shear walls		$0.05f'_c$		100	125	150	187
Bond: u							
Deformed bars							
Top bars†	u	$0.07f'_c$	245	140	175	210	245
In 2-way footings (except top bars)	u	$0.08f'_c$	280	160	200	240	280
All others	u	$0.10f'_c$	350	200	250	300	350
Plain bars (must be hooked)							
Top bars	u	$0.03f'_c$	105	60	75	90	105
In 2-way footings (except top bars)	u	$0.036f'_c$	126	72	90	108	126
All others	u	$0.045f'_c$	158	90	113	135	158
Bearing: f_c							
On full area	f_c	$0.25f'_c$		500	625	750	938
On one-third area or less‡	f_c	$0.375f'_c$		750	938	1125	1405
Pedestals [See Sec. 2621(e)]							

*See Sec. 2617(g). **See Secs. 2617(h), 2618(e), and 2624(e).

†Top bars are horizontal bars so placed that more than 12 in. of concrete is cast in the member below the bar.

‡The allowable bearing stress on an area greater than one-third but less than the full area shall be interpolated between the values given.

Flexural Computations

Sec. 2614. All members shall be designed to resist at all sections the maximum bending moments and shears produced by dead load, live load and other loads, as determined by the principle of continuity. In the case of approximately equal spans with loads uniformly distributed, where the intensity of live load does not exceed three times the intensity of dead load, this is satisfied essentially by the following values:

Negative moment at face of first interior support:

For beams and girders and for slabs exceeding ten feet (10′):

Two spans $\frac{1}{8} wl'^2$

More than two spans $\frac{1}{10} wl'^2$

For slabs not exceeding 10 feet in span

Two spans $\frac{1}{10} wl'^2$

More than two spans $\frac{1}{12} wl'^2$

Negative moment at face of other interior supports $\frac{1}{12} wl'^2$

Positive moment at center of span

End spans $\frac{1}{10} wl'^2$

Interior spans $\frac{1}{12} wl'^2$

Shear in end members at first interior support $1.20 \frac{wl'}{2}$

Shear at other supports $\frac{wl'}{2}$

For the purpose of applying this method, "approximately" shall be construed to mean that the longer of two adjacent spans shall not exceed the shorter by more than 20 per cent. In these expressions $l' =$ the clear span for positive moments and the average of the two adjacent clear spans for negative moment.

(a) **Permissible Assumptions.** The span length of freely supported beams and slabs shall be the clear span plus the depth of beam or slab, but shall not exceed the distance between centers of the supports.

In the application of the principle of continuity, the following assumptions shall be permissible:

1. Consideration may be limited to combinations of dead

Flexural Computations (Cont'd.)

load on all spans with full live load on two adjacent spans and with full live load on alternate spans.

2. Any reasonable and consistent assumption may be made as to the relative stiffness of the floor construction and columns. In computing the relative stiffness of floors to columns, the value I of the floor members may be based on the entire concrete section neglecting the reinforcement, and that of columns on the entire concrete section plus the transformed steel section. The moment of inertia assumed for the columns in computing bending moments must also be used in computing stresses.

3. The far ends of columns above and below the floor under consideration may be considered fixed.

4. When members are deepened near their ends by haunches they may be analyzed as members of constant section provided the minimum depth is used throughout in computing stresses due to bending; otherwise a complete analysis is required. Where members are widened near their supports the additional width may be neglected in computing moments but may be used in computing stresses.

Additional section at the end may in any case be utilized in resisting shear if properly reinforced.

5. Where slabs of uniform thickness are built integrally with their supports the span length may be taken equal to the clear span between faces of supports and the width of support otherwise neglected.

6. In the application of the principle of continuity, center to center distances may be used in the moment determination of all members.

Moments prevailing at the faces of support may be used to proportion the members at these sections.

7. In slabs other than ribbed floor construction or flat slabs, the principal reinforcement shall not be spaced farther apart than three times the slab thickness.

8. Where analysis indicates negative reinforcement along the full length of a span, the reinforcement need not be extended beyond the point where the required amount is .0025 $b'd$ or less.

9. In structural slabs of uniform thickness the minimum amount of reinforcement in the direction of principal stress shall be

For structural, intermediate and hard grades and rail steel..... .0025 bd

For steel having a minimum yield point of 56,000 lb. per sq. in..... .002 bd

(b) **Distance between Lateral Supports.** The clear distance between lateral supports of a beam shall not exceed 32 times the least width of compression flange.

(c) **Depth of Beam or Slab.** The depth of the beam or slab shall be taken as the distance from the centroid of the tensile reinforcement to the compression face of the structural member. Any floor finish not placed monolithically with the floor slab shall not be included as a part of the structural member. When the finish is placed mono-

lithically with the structural slab in buildings of the warehouse or industrial class, the over-all depth shall be at least one-half inch (½") over that required by the design of the member. **Flexural Computations (Cont'd.)**

(d) **Requirements for T-Beams.** 1. In T-beam construction the slab and beam shall be built integrally or otherwise effectively bonded together. The effective flange width to be used in the design of symmetrical T-beams shall not exceed one-fourth of the span length of the beam, and its overhanging width on either side of the web shall not exceed eight times the thickness of the slab nor one-half the clear distance to the next beam.

2. For beams having a flange on one side only, the effective overhanging flange width shall not exceed one-twelfth of the span length of the beam, nor six times the thickness of the slab, nor one-half the clear distance to the nearest beam.

3. Where the principal reinforcement in a slab which is considered as the flange of a T-beam (not a rib in ribbed floors) is parallel to the beam, transverse reinforcement shall be provided in the top of the slab. This reinforcement shall be designed to carry the load on the portion of the slab assumed as the flange of the T-beam. The spacing of the bars shall not exceed five times the thickness of the flange, nor in any case eighteen inches (18").

4. Provisions shall be made for the compressive stress at the support in continuous T-beam construction, care being taken that the provisions of Section 2610 relating to the spacing of bars, and Section 2609 (e), relating to the placing of concrete shall be fully met.

5. The overhanging portion of the flange of the beam shall not be considered as effective in computing the shear and diagonal tension resistance of T-beams.

6. Isolated beams in which the T-form is used only for the purpose of providing additional compression area, shall have a flange thickness not less than one-half the width of the web and a total flange width not more than four times the web thickness.

(e) **One-way Ribbed Floor Construction.** 1. Ribbed floor construction consists of concrete ribs and slabs placed monolithically with or without burned clay or concrete tile fillers. The ribs shall not be farther apart than thirty inches (30") face to face. The ribs shall be straight, not less than four inches (4") wide, nor of a depth more than three times the width.

2. When burned clay or concrete tile fillers, of material having a unit compressive strength at least equal to that of the designed strength of the concrete in the ribs, are used, and the fillers are so placed that the joints in alternate rows are staggered, the shells of the fillers in contact with the ribs may be included in the calculations involving shear or negative bending moment. No other portion of the fillers may be included in the design calculations.

3. The concrete slab over the fillers shall be not less than one and one-half inches (1½") in thickness, nor less in thickness than one-twelfth of the clear distance between ribs.

Flexural Computations (Cont'd.)

Shrinkage reinforcement in the slab shall be provided as specified in Section 2615.

4. Where removable forms or fillers not complying with paragraph 2 of this subsection are used, the thickness of the concrete slab shall not be less than one-twelfth of the clear distance between ribs and in no case less than two inches (2"). Such slab shall be reinforced at right angles to the ribs with a minimum of .049 square inches of reinforcing steel per foot of width, and in slabs on which the prescribed live load does not exceed 50 pounds per square foot, no additional reinforcement will be required.

5. When the finish used as a wearing surface is placed monolithically with the structural slab in buildings of the warehouse or industrial class, the thickness of the concrete over the fillers shall be one-half inch (½") greater than the thickness used for design purposes.

6. Where the slab contains conduits or pipes, the thickness shall be not less than one inch (1") plus the total over-all depth of such conduits or pipes at any point. Such conduits or pipes shall be so located as not to impair the strength of the construction.

(f) **Compression Steel in Flexural Members.** Compression steel in beams, girders, or slabs shall be anchored by ties or stirrups not less than one-fourth inch (¼") in diameter, spaced no farther apart than 16 bar diameters or 48 tie diameters. Such ties or stirrups shall be used throughout the distance where compression steel is required.

The effectiveness of compression reinforcement in resisting bending may be taken at twice the value indicated from calculations assuming a straight line relation between stress and strain and the modular ratio given in Section 2611, but not of greater value than the allowable stress in tension.

Shrinkage and Temperature Reinforcement

Sec. 2615. Reinforcement for shrinkage and temperature stresses normal to the principal reinforcement shall be provided in floor and roof slabs where the principal reinforcement extends in one direction only. Such reinforcement shall provide for the following minimum ratios of reinforcement area to concrete area (bd), but in no case shall such reinforcing bars be placed farther apart than five times the slab thickness nor more than eighteen inches (18").

Floor slabs where plain bars are used	0.0025
Floor slabs where deformed bars are used	0.002
Floor slabs where wire fabric is used, having welded intersections not farther apart in the direction of stress than 12 inches	0.0018
Roof slabs where plain bars are used	0.003
Roof slabs where deformed bars are used	0.0025
Roof slabs where wire fabric is used, having welded intersections not farther apart in the direction of stress than 12 inches	0.0022

Two-Way Slabs

Sec. 2616. (a) **General.** This construction, consisting of floors reinforced in two directions and supported on four sides, includes solid reinforced concrete slabs, concrete joists with fillers of hollow concrete units or clay tile, with or without concrete top slabs; and concrete joists with top

slabs placed monolithically with the joists. The slab shall be supported by walls or beams on all sides and if not securely attached to supports, shall be reinforced as specified in Subsection (b). **Two-Way Slabs (Cont'd.)**

(b) **Reinforcement.** Where the slab is not securely attached to the supporting beams or walls, special reinforcement shall be provided at exterior corners in both the bottom and top of the slab. This reinforcement shall be provided for a distance in each direction from the corner equal to one-fifth the longest span. The reinforcement in the top of the slab shall be parallel to the diagonal from the corner. The reinforcement in the bottom of the slab shall be at right angles to the diagonal or may be of bars in two directions parallel to the sides of the slab. The reinforcement in each band shall be of equivalent size and spacing to that required for the maximum positive moment in the slab.

(c) **Design.** The slab and its supports shall be designed by approved methods which shall take into account the effect of continuity at supports, the ratio of length to width of slab and the effect of two-way action.

(d) **Slab Thickness.** In no case shall the slab thickness be less than four inches (4") nor less than the perimeter of the slab divided by 180. The spacing of reinforcement shall be not more than three times the slab thickness and the ratio of reinforcement shall be at least 0.0025.

(e) **Details.** The details of design of two-way slabs shall conform to U.B.C. Standard No. 26-12.

Sec. 2617. (a) **Shearing Unit Stress.** The shearing unit stress (v) in reinforced concrete flexural members shall be computed by formula (2): **Shear and Diagonal Tension**

$$v = \frac{V}{bjd} \qquad (2)$$

For beams of I or T section b' shall be substituted for b in Formula (2).

In ribbed construction, where burned clay or concrete tile are used, b' may be taken as a width equal to the thickness of the concrete web plus the thickness of the vertical shells of the concrete or burned clay tile in contact with the joist as specified in Sections 2614 and 2616.

Where the value of the shearing unit stress computed by Formula (2) exceeds the shearing unit stress (v_c) permitted on the concrete of an unreinforced web (see Section 2613), web reinforcement shall be provided to carry the excess.

(b) **Types of Web Reinforcement.** Web reinforcement may consist of:

1. Stirrups or web reinforcement bars perpendicular to the longitudinal steel.

2. Stirrups or web reinforcement bars welded or otherwise rigidly attached to the longitudinal steel and making an angle of 30 degrees or more thereto.

3. Longitudinal bars bent so that the axis of the inclined portion of the bar makes an angle of 15 degrees or more with the axis of the longitudinal portion of the bar.

4. Special arrangements of bars with adequate provisions

Shear and Diagonal Tension (Cont'd.)

to prevent slip of bars or splitting of the concrete by the reinforcement [See Subsection (d), last paragraph].

Stirrups or other bars to be considered effective as web reinforcement shall be anchored at both ends, according to the provisions of Section 2618.

(c) **Stirrups.** The area of steel required in stirrups placed perpendicular to the longitudinal reinforcement shall be computed by Formula (3).

$$A_v = \frac{V's}{f_v jd} \qquad (3)$$

Inclined stirrups shall be proportioned by Formula (5).

Stirrups placed perpendicular to the longitudinal reinforcement shall not be used alone as web reinforcement when the shearing unit stress (v) exceeds $0.08f'_c$.

(d) **Bent Bars.** When the web reinforcement consists of a single bent bar or of a single group of bent bars the required area of such bars shall be computed by Formula (4).

$$A_v = \frac{V'}{f_v \sin \alpha} \qquad (4)$$

In Formula (4) V' shall not exceed $0.40f'_c\ bjd$.

Only the center three-fourths of the inclined portion of such bar, or group of bars, shall be considered effective as web reinforcement.

Where there is a series of parallel bent bars, the required area shall be determined by Formula (5).

$$A_v = \frac{V's}{f_v jd\ (\sin \alpha + \cos \alpha)} \qquad (5)$$

When bent bars having a radius of bend of not more than two times the diameter of the bar are used alone as web reinforcement, the allowable shearing unit stress shall not exceed $0.060f'_c$. This shearing unit stress may be increased at the rate of $0.01f'_c$ for each increase of four bar diameters in the radius of bend until the maximum allowable shearing unit stress is reached. (See Section 2613).

The shearing unit stress permitted when special arrangements of bars are employed shall be that determined by making comparative tests, to destruction, of specimens of the proposed system and of similar specimens reinforced in conformity with the provisions of this Code, the same factor of safety being applied in both cases.

(e) **Combined Web Reinforcement.** Where more than one type of reinforcement is used to reinforce the same portion of the web, the total shearing resistance of this portion of the web shall be assumed as the sum of the shearing resistances computed for the various types separately. In such computations the shearing resistance of the concrete shall be included only once, and no one type of reinforcement shall be assumed to resist more than $\frac{2V'}{3}$

(f) **Spacing of Web Reinforcement.** Where web reinforce-

ment is required it shall be so spaced that every 45-degree line (representing a potential crack) extending from the mid-depth of the beam to the longitudinal tension bars shall be crossed by at least one line of web reinforcement. If a unit shearing stress in excess of $0.06f'_c$ is used, every such line shall be crossed by at least two such lines of web reinforcement. **Shear and Diagonal Tension (Cont'd.)**

(g) **Shearing Stress in Flat Slabs.** In flat slabs, the shearing unit stress on a vertical section which lies at a distance $t_1 - 1\frac{1}{2}$ inches beyond the edge of the column capital and parallel with it, shall not exceed the following values when computed by formula (2) (in which d shall be taken as $t_1 - 1\frac{1}{2}$ inches):

1. $0.03\ f'_c$, when at least 50 per cent of the total negative reinforcement in the column strip passes directly over the column capital.

2. $0.025\ f'_c$, when 25 per cent of the total negative reinforcement in the column strip passes directly over the column capital.

3. For intermediate percentages, intermediate values of the shearing unit stress shall be used.

In flat slabs, the shearing unit stress on a vertical section which lies at a distance of $t_2 - 1\frac{1}{2}$ inches beyond the edge of the dropped panel and parallel with it shall not exceed $0.03f'_c$ when computed by formula (2) in which d shall be taken as $t_2 - 1\frac{1}{2}$ inches. At least 50 per cent of the cross-sectional area of the negative reinforcement in the column strip must be within the width of strip directly above the dropped panel.

(h) **Shear and Diagonal Tension in Footings.** In isolated footings the shearing unit stress computed by formula (2) on the critical section [see Sec. 2621 (d)] shall not exceed $0.03f'_c$, nor in any case shall it exceed 75 psi.

Sec. 2618. (a) **Computation of Bond Stress in Beams.** In flexural members in which the tensile reinforcement is parallel to the compression face, the bond stress at any cross section shall be computed by Formula (6). **Bond and Anchorage**

$$u = \frac{V}{\Sigma_o jd} \qquad (6)$$

in which V is the shear at that section.

Adequate end anchorage shall be provided for the tensile reinforcement in all flexural members to which Formula (6) does not apply, such as footings, brackets and other tapered or stepped beams in which the tensile reinforcement is not parallel to the compression face.

(b) **Anchorage Requirements.** Tensile negative reinforcement in any span of a continuous, restrained, or cantilever beam, or in any member of a rigid frame shall be adequately anchored by bond, hooks or mechanical anchors in or through the supporting member. Within any such span every reinforcing bar shall be extended at least 12 diameters beyond the point at which it is no longer needed to resist stress. The maximum tension in any bar must be developed by bond on a sufficient straight or bent embedment or by other anchorage [see Section 2618 (f)].

Bond and Anchorage (Cont'd.)

Of the positive reinforcement in continuous beams not less than one-fourth the area shall extend along the same face of the beam into the support a distance of six inches (6").

In simple beams, or at the freely supported end of continuous beams, at least one-third the required positive reinforcement shall extend along the same face of the beam into the support a distance of six inches (6").

(c) **Plain Bars in Tension.** Plain bars in tension shall terminate in standard hooks except that hooks shall not be required on the positive reinforcement at interior supports of continuous members.

(d) **Anchorage of Web Reinforcement.** Single separate bars used as web reinforcement shall be anchored at each end by one of the following methods:

1. Welding to longitudinal reinforcement.

2. Hooking tightly around the longitudinal reinforcement through 180 degrees.

3. Embedment in the compression area of the beam a distance sufficient to develop the allowable tensile stress specified in Section 2613 at a bond stress not exceeding $0.045f'_c$ on plain bars nor $0.10f'_c$ on deformed bars.

4. Standard hook, considered as developing 10,000 pounds per square inch, plus embedment sufficient to develop by bond the remainder of the stress to which the bar is subjected. The unit bond stress shall not exceed that set forth in Table No. 26-B. The effective embedded length shall not be assumed to exceed the distance between the mid-depth of the beam and the tangent of the hook.

The extreme ends of bars forming simple *U* or multiple stirrups shall be anchored by one of the methods of Subsection (d) or shall be bent through an angle of at least 90 degrees tightly around a longitudinal reinforcing bar not less in diameter than the stirrup bar, and shall project beyond the bend at least 12 diameters of the stirrup bar.

The loops or closed ends of such stirrups shall be anchored by bending around the longitudinal reinforcement through an angle of at least 90 degrees, or by being welded or otherwise rigidly attached thereto.

Hooking or bending stirrups or separate web reinforcement bars around the longitudinal reinforcement shall be considered effective only when these bars are perpendicular to the longitudinal reinforcement.

Longitudinal bars bent to act as web reinforcement shall, in a region of tension, be continuous with the longitudinal reinforcement. The tensile stress in each bar shall be fully developed in both the upper and the lower half of the beam by one of the following methods:

I. As specified in Subsection (d)-3.

II. As specified in Subsection (d)-4.

III. By bond, at unit bond stress not exceeding $0.045f'_c$ on plain bars nor $0.10f'_c$ on deformed bars, a bend of radius not less than two times the diameter of the bar, plus an extension of the bar parallel to the upper or lower surface of

Bond and Anchorage (Cont'd.)

the beam, of not less than 12 diameters of the bar, plus a standard hook. This short radius bend extension and hook shall together not be counted upon to develop a tensile unit stress in the bar of more than 10,000 pounds per square inch.

IV. By bond, at a unit bond stress not exceeding $0.045f'_c$ on plain bars nor $0.10f'_c$ on deformed bars, plus a bend of radius not less than two times the diameter of the bar, parallel to the upper or lower surface of the beam and continuous with the longitudinal reinforcement. The short radius bend and continuity shall together not be counted upon to develop a tensile unit stress in the bar of more than 10,000 pounds per square inch.

V. The tensile unit stress at the beginning of a bend may be increased from 10,000 pounds per square inch when the radius of bend is two bar diameters, at the rate of 1,000 pounds per square inch tension for each increase of one and one-half bar diameters in the radius of bend, provided that the length of the bar in the bend and extension is sufficient to develop this increased tensile stress by bond at the unit stresses given in Subsection (d)-III.

In all cases web reinforcement shall be carried as close to the compression surface of the beam as fireproofing regulations and the proximity of other steel will permit.

(e) **Anchorage of Bars in Footing Slabs.** Plain bars in footing slabs, except the longitudinal reinforcement between loads in continuous slab footings, shall be anchored by means of standard hooks. The outer faces of these hooks and the ends of deformed bars shall be not less than three inches (3″) nor more than six inches (6″) from the face of the footing.

(f) **Hooks.** The terms "hook" or "standard hook" as used herein shall mean a complete semicircular turn with a radius of bend on the axis of the bar of not less than three and not more than six bar diameters, plus an extension of at least four bar diameters at the free end of the bar or a 90-degree bend having a radius of not less than four bar diameters plus an extension of 12 bar diameters. Hooks having a radius of bend of more than six bar diameters shall be considered merely as extensions to the bars, and shall be treated as in Subsection (d)-V.

In general, hooks shall not be permitted in the tension portion of any beam except at the ends of simple or cantilever beams or at the freely supported ends of continuous or restrained beams.

No hook shall be assumed to carry a load which would produce a tensile stress in the bar greater than 10,000 pounds per square inch.

Hooks shall not be considered effective in adding to the compressive resistance of bars.

Any mechanical device capable of developing the strength of the bar without damage to the concrete may be used in lieu of a hook. Tests must be presented to show the adequacy of such devices.

Flat Slabs

Sec. 2619. (a) Scope. The term flat slab shall mean a reinforced concrete slab supported by columns with or without

Flat Slabs (Cont'd.)

flaring heads or column capitals, with or without depressed or drop panels and generally without beams or girders. Recesses or pockets in flat slab ceilings, located between reinforcing bars and forming cellular or two-way ribbed ceilings, whether left open or filled with permanent fillers, shall not prevent a slab from being considered a flat slab; but allowable unit stresses shall not be exceeded.

(b) **Design of Flat Slabs as Continuous Frames.** Any type of flat slab construction may be designed by application of the principles of continuity.

(c) **Design of Flat Slabs by Moment Coefficients.** Arbitrary coefficients may be used when the construction conforms with the following:

1. The ratio of length to width of panel does not exceed 1.33.
2. The slab is continuous for at least three panels in each direction.
3. The successive span lengths in each direction differ by not more than 20 per cent of the shorter span.

(d) **Details.** The details of the design and construction of flat slabs shall conform to U.B.C. Standard No. 26-13.

Reinforced Concrete Columns and Walls

Sec. 2620. (a) **Limiting Dimensions.** The following subsections on reinforced concrete and composite columns except Subsection (g) apply to a short column, for which the unsupported length is not greater than 10 times the least lateral dimension. When the unsupported length exceeds this value, the design shall be modified as shown in Subsection (g). Principal columns in buildings shall have a minimum diameter of twelve inches (12"), or in the case of rectangular columns, a minimum thickness of ten inches (10") and a minimum gross area of one hundred and twenty square inches (120 sq. in.). Posts that are not continuous from story to story shall have a minimum diameter or thickness of six inches (6").

(b) **Unsupported Length of Columns.** For purposes of determining the limiting dimensions of columns, the unsupported length of reinforced concrete columns shall be taken as the clear distance between floor slabs.

EXCEPTIONS: 1. In flat slab construction, it shall be the clear distance between the floor and the lower extremity of the capital.

2. In beam and slab construction, it shall be the clear distance between the floor and the under side of the deeper beam framing into the column in each direction at the next higher floor level.

3. In columns restrained laterally by struts, it shall be the clear distance between consecutive struts in each vertical plane; provided that to be an adequate support, two such struts shall meet the column at approximately the same level, and the angle between vertical planes through the struts shall not vary more than 15 degrees from a right angle. Such struts shall be of adequate dimensions and anchorage to restrain the column against lateral deflection.

4. In columns restrained laterally by struts or beams, with brackets used at the junction, it shall be the clear distance between the floor and the lower edge of the bracket, provided that the bracket width equals that of the beam or strut and is at least half that of the column.

For rectangular columns, that length shall be considered which produces the greatest ratio of length to depth of section.

(c) **Spirally Reinforced Columns. 1. Permissible Load**—The maximum permissible axial load, P, on columns with closely spaced spirals enclosing a circular concrete core reinforced with longitudinal bars shall be that given by Formula (7).

$$P = A_g\ (0.225f'_c + f_s p_g) \quad \text{.....(7)}$$

WHERE

A_g = the gross area of the column.

f'_c = compressive strength of the concrete.

f_s = nominal working stress in vertical column reinforcement, to be taken at 40 per cent of the minimum specification value of the yield point; viz., 16,000 pounds per square inch for intermediate grade steel and 20,000 pounds per square inch for rail or hard grade steel.*

p_g = ratio of the effective cross-sectional area of vertical reinforcement to the gross area, A_g.

2. **Vertical Reinforcement**—The ratio (p_g) shall not be less less than 0.01 nor more than 0.08. The minimum number of bars shall be six, and the minimum diameter shall be five-eighths inch (⅝"). The center to center spacing of bars within the periphery of the column core shall be not less than two and one-half times the diameter for round bars or three times the side dimension for square bars. The clear spacing between bars shall be not less than one and one-half inches (1½"), or one and one-half times the maximum size of the coarse aggregate used. These spacing rules apply to adjacent pairs of bars at a lapped splice.

3. **Splices in Vertical Reinforcement**—Where lapped splices in the column verticals are used, the minimum amount of lap shall be as follows:

I. For deformed bars with concrete having an ultimate strength of 3000 pounds per square inch or above, 20 diameters of bar of intermediate or hard grade steel. For bars of higher yield point, the amount of lap shall be increased one diameter for each 1000 pounds per square inch above 20,000 pounds per square inch working stress. When the concrete strengths are less than 3000 pounds per square inch, the amount of lap shall be one-third greater than the values given above.

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*Nominal working stresses for reinforcement of higher yield point may be established at 40 per cent of the yield point stress, but not more than 30,000 pounds per square inch, when the properties of such reinforcing steels have been definitely specified. If this is done, the lengths of splice required by Section 2620 (c)-3 shall be increased accordingly.

Reinforced Columns and Walls (Cont'd.)

II For plain bars—the minimum amount of lap shall be 100 per cent greater than that specified for deformed bars.

III Welded splices or other positive connections may be used instead of lapped splices. Welded splices shall preferably be used in cases where the bar diameter exceeds one and one-half inch (1½"). An approved welded splice shall be defined as one in which the bars are butted and welded and that will develop in tension at least the yield point stress of the reinforcing steel used.

IV Where changes in the cross section of a column occur, the longitudinal bars shall be offset in a region where lateral support is afforded by a concrete capital, floor slab or by metal ties or reinforcing spirals. Where bars are offset, the slope of the inclined portion from the axis of the column shall not exceed one in six and the bars above and below the offset shall be parallel to the axis of the column.

4. **Spiral Reinforcement**—The ratio of spiral reinforcement, (p') shall be not less than the value given by Formula (8).

$$p' = 0.45\ (R-1)\frac{f'_c}{f'_s} \qquad (8)$$

WHERE

p' = ratio of volume of spiral reinforcement to the volume of the concrete core (out to out of spirals).

R = ratio of gross area to core area of column, A_g/A_c.

f'_s = useful limit stress of spiral reinforcement, to be taken as 40,000 pounds per square inch for hot rolled rods of intermediate grade, 50,000 pounds per square inch for hard grade, and 60,000 pounds per square inch for cold drawn wire.

The spiral reinforcement shall consist of evenly spaced continuous spirals held firmly in place and true to line by vertical spacers using at least two for spirals twenty inches (20") or less in diameter, three for spirals twenty inches (20") to thirty inches (30") in diameter and four for spirals more than thirty inches (30") in diameter or composed of spiral rods five-eighths inch (⅝") or larger in size. The spirals shall be of such size and so assembled as to permit handling and placing without being distorted from the design dimensions. The material used in spirals shall have a minimum diameter of one-fourth inch (¼") for rolled bars or No. 4 W.&M. gauge for drawn wire. Anchorage of spiral reinforcement shall be provided by one and one-half extra turns of spiral rod or wire at each end of the spiral unit. Splices, when necessary, shall be made in spiral rod or wire by welding or by a lap of one and one-half turns. The center to center spacing of the spirals shall not exceed one-sixth of the core diameter. The clear spacing between spirals shall not exceed three inches (3") nor be less than one and three-eighths inches (1⅜") or one and one-half times the maximum size of coarse aggregate used. The reinforcing

Reinforced Columns and Walls (Cont'd.)

spiral shall extend from the floor level in any story, or from the top of the footing in the basement, to the level of the lowest horizontal reinforcement in the slab, dropped panel or beam above. In a column with a capital, it shall extend to the plane at which the diameter or width of the capital is twice that of the column.

5. **Protection of Reinforcement**—The column reinforcement shall be protected everywhere by a covering of concrete cast monolithically with the core, for which the thickness shall not be less than one and one-half inches (1½") nor less than one and one-half times the maximum size of the coarse aggregate, nor shall it be less than required by the fire protection and weathering provisions specified in Section 2610 (f).

6. **Limits of Column Section**—For columns built monolithically with concrete walls or piers, the outer boundary of the column section shall be taken either as a circle at least one and one-half inches (1½") outside the column spiral or as a square or rectangle of which the sides are at least one and one-half inches (1½") outside the spiral. The value of A_g thus defined shall be used in both Formulas (7) and (8). In any case it shall be permissible to design a circular column and to build it as a square column of the same least lateral dimension. In such case the permissible load, the gross area considered, and the required percentage of reinforcement must be taken as those of the circular column.

(d) **Tied Columns. 1. Permissible Load**—The maximum permissible axial load on columns reinforced with longitudinal bars and separate lateral ties shall be 80 per cent of that given by Formula (7). The ratio, (p_g), to be considered in tied columns shall be not less than 0.01 nor more than 0.04. The longitudinal reinforcement shall consist of at least four bars, of minimum diameter of five-eighths inch (⅝"). Splices in reinforcing bars shall be made as described in Subsection (c)-3.

2. **Lateral Ties**—Lateral ties shall be at least one-fourth inch (¼") in diameter and shall be spaced apart not over 16 bar diameters, 48 tie diameters or the least dimension of the column. When there are more than four vertical bars, additional ties shall be provided so that every longitudinal bar is held firmly in its designed position and has lateral support equivalent to that provided by a 90-degree corner of a tie.

3. **Limits of Column Section**—In a tied column which for architectural reasons has a larger cross section than required by consideration of loading, a reduced effective area (A_g) not less than one-half of the total area may be used in applying the provisions of Subsection (d)-1.

(e) **Composite Columns. 1. Permissible Load**—The permissible load on a composite column consisting of a structural steel or cast-iron column thoroughly encased in concrete reinforced with both longitudinal and spiral reinforcement, shall not exceed that given by Formula (9).

Reinforced Columns and Walls (Cont'd.)

$$P = 0.225A_c f'_c + f_s A_s + f_r A_r \quad \text{.....(9)}$$

WHERE

A_c = net area of concrete
$= A_g - A_s - A_r$.

A_s = cross-sectional area of longitudinal bar reinforcement.

A_r = cross-sectional area of the steel or cast-iron core.

f_r = permissible unit stress in metal core, not to exceed 16,000 pounds per square inch for a steel core; or 10,000 pounds per square inch for a cast-iron core.

The remaining notation is that of Subsection (c).

2. Details of Metal Core and Reinforcement—The cross-sectional area of the metal core shall not exceed 20 per cent of the gross area of the column. If a hollow metal core is used it shall be filled with concrete. The amounts of longitudinal and spiral reinforcement and the requirements as to spacing of bars, details of splices and thickness of protective shell outside the spiral shall conform to the limiting values specified in Subsection (c), paragraphs 2, 3, 4, and 5. A clearance of at least three inches (3") shall be maintained between the spiral and the metal core at all points except that when the core consists of a structural steel H-column, the minimum clearance may be reduced to two inches (2").

3. Splices and Connections of Metal Cores—Metal cores in composite columns shall be accurately milled at splices and positive provision shall be made for alignment of one core above another. At the column base, provision shall be made to transfer the load to the footing at safe unit stresses in accordance with Section 2613 and Table No. 26-B. The base of the metal section shall be designed to transfer the load from the entire composite column to the footing, or it may be designed to transfer the load from the metal section only, provided it is so placed in the pier or pedestal as to leave ample section of concrete above the base for the transfer of load from reinforced concrete section of the column by means of bond on the vertical reinforcement and by direct compression on the concrete. Transfer of loads to the metal core shall be provided for by the use of bearing members such as billets, brackets or other positive connections; these shall be provided at the top of the metal core and at intermediate floor levels where required. The column as a whole shall satisfy the requirements of Formula (9) at any point; in addition to this, the reinforced concrete portion shall be designed to carry, in accordance with Formula (7), all floor loads brought onto the column at levels between the metal brackets or connections. In applying Formula (7), the value of A_g shall be interpreted as the area of the concrete section outside the metal core, and the permissible load on the reinforced concrete section shall be further limited to $0.35f'_c A_g$. Ample section of concrete and continuity of reinforcement shall be provided at the junction with beams or girders.

4. Permissible Load on Metal Core Only—The metal cores of composite columns shall be designed to carry safely any

construction or other loads to be placed upon them prior to their encasement in concrete.

(f) **Combination Columns. 1. Steel Columns Encased in Concrete**—The permissible load on a structural steel column which is encased in concrete at least two and one-half inches (2½″) thick over all metal (except rivet heads) reinforced as hereinafter specified, shall be computed by Formula (10).

$$P = A_r f'_r \left(1 + \frac{A_g}{100\, A_r} \right) \quad \text{.....(10)}$$

WHERE

A_r = cross-sectional area of steel column.

f'_r = permissible stress for unencased steel column.

A_g = total area of concrete section.

The concrete used shall develop a compressive strength (f'_c) of at least 2000 pounds per square inch at 28 days. The concrete shall be reinforced by the equivalent of welded wire mesh having wires of No. 10 W. & M. gauge, the wires encircling the column being spaced not more than four inches (4″) apart and those parallel to the column axis not more than eight inches (8″) apart. This mesh shall extend entirely around the column at a distance of one inch (1″) inside the outer concrete surface and shall be lap-spliced at least 40 wire diameters and wired at the splice. Special brackets shall be used to receive the entire floor load at each floor level. The steel column shall be designed to carry safely any construction or other loads to be placed upon it prior to its encasement in concrete.

2. **Pipe Columns**—The permissible load on columns consisting of steel pipe filled with concrete shall be determined by Formula (11).

$$P = 0.225 f'_c A_c + f'_r A_r \quad \text{.....(11)}$$

The value of f'_r shall be that given by Formula (12).

$$f'_r = \left(18{,}000 - 70 \frac{h}{K} \right) F \quad \text{.....(12)}$$

WHERE

f'_r = average unit stress in metal core.

h = unsupported length of column.

K = least radius of gyration of metal core section.

$$F = \frac{\text{(yield point of pipe)}}{45{,}000}$$

If the yield point of the pipe is not known, the factor F shall be taken as 0.5.

(g) **Long Columns.** The maximum permissible load P' on axially loaded reinforced concrete or composite columns having a length, (h), greater than 10 times the least lateral dimension, (d), shall be given by Formula (13).

$$P' = P \left(1.3 - .03 \frac{h}{d} \right) \quad \text{.....(13)}$$

Reinforced Columns and Walls (Cont'd.)

where P is the permissible axial load on a short column as given by Subsections (c), (d) and (e).

The maximum permissible load P' on eccentrically loaded columns in which $\frac{h}{d}$ exceeds 10 shall also be given by Formula (13) in which P is the permissible eccentrically applied load on a short column as determined by the provisions of Subsections (i) and (j). In long columns subjected to definite bending stresses, as determined in Subsection (h), the ratio h/d shall not exceed 20.

(h) **Bending Moments in Columns.** When the stiffness and strength of the columns are utilized to reduce moments in beams, girders, or slabs, as in the case of rigid frames, or in other forms of continuous construction wherein column moments are unavoidable, they shall be provided for in the design. In computing moments in columns, the far ends may be considered fixed. Columns shall be designed to resist the axial forces from loads on all floors, plus the maximum bending due to loads on a single adjacent span of the floor under consideration.

(i) **Determination of Combined Axial and Bending Stresses.** In a reinforced concrete column, designed by the methods of this Chapter, which is (1) symmetrical about two perpendicular planes through its axis and (2) subject to an axial load, N, combined with bending in one or both of the planes of symmetry (but with the ratio of eccentricity to depth, e/t, no greater than 1.0 in either plane), the combined fiber stress in compression may be computed on the basis of recognized theory applying to uncracked sections, using Formula (14).

$$f_c = \frac{N}{A_g}\left[\frac{1 + \frac{De}{t}}{1 + (n-1)p_g}\right] \qquad (14)$$

WHERE

$D = \frac{t^2}{2R^2}$ = a factor, usually varying from 3 to 9. (The term R as used here is the radius of gyration of the entire column section.)

t = overall depth of column section.

Equating this calculated stress, f_c, to be the allowable stress, f_p, in Formula (16) it follows that the column can be designed for an equivalent axial load, P, as given by Formula (15).*

$$P = N\left[1 + \frac{C\,De}{t}\right] \qquad (15)$$

WHERE

C = ratio of allowable concrete stress, f_a, in axially loaded column to allowable fiber stress for concrete in flexure.

*For approximate or trial computations, D may be taken as eight for a circular spiral column and as five for a rectangular tied or spiral column.

When bending exists on both axes of symmetry, the quantity $\frac{De}{t}$ shall be computed as the numerical sum of the $\frac{De}{t}$ quantities in the two directions.

For columns in which the load, N, has an eccentricity, e, greater than the column depth, t, or for beams subject to small axial loads, the determination of the fiber stress f_c shall be made by use of recognized theory for cracked sections, based on the assumption that no tension exists in the concrete. For such cases the tensile steel stress shall also be investigated.

(j) **Allowable Combined Axial and Bending Stress.** For spiral and tied columns, eccentrically loaded or otherwise subjected to combined axial compression and flexural stress, the maximum allowable compressive stress, f_p, is given by Formula (16).

$$f_p = f_a \left[\frac{1 + \frac{De}{t}}{1 + \frac{C\,De}{t}} \right] = f_a \left[\frac{t + De}{t + C\,De} \right] \qquad (16)$$

WHERE

$D = \frac{t^2}{2R^2}$ = a factor, usually varying from 3 to 9. (The term R as used here is the radius of gyration of the entire column section.)

t = overall depth of column section.

f_a = average allowable stress in the concrete of an axially loaded reinforced concrete column.

C = ratio of f_a to the allowable fiber stress for members in flexure.

Thus

$$f_a = \left[\frac{0.225\, f'_c + f_s p_g}{1 + (n-1)\, p_g} \right]$$

for spiral columns and 0.8 of this value for tied columns, and

$$C = \frac{f_a}{0.45\, f'_c}$$

For tied columns which are designed to withstand combined axial and bending stresses, the limiting total steel ratio of 0.04 prescribed in Subsection (d) may be increased to 0.08, provided that the amount of steel spliced by lapping shall not exceed a steel ratio of 0.04 in any three-foot (3') length of column. The size of the column designed under this provision shall in no case be less than that required to withstand axial load alone as specified in Subsection (d).

(k) **Walls. 1. Lateral and Eccentric Loads.** Walls shall be designed for any lateral or other loads to which they are

Reinforced Columns and Walls Cont'd.)

subjected. Proper provision shall be made for eccentric loads.

2. **Height and Thickness.** The thickness of reinforced concrete bearing walls shall be not less, and the maximum height, number of stories, and distance between supports shall be not more, than shown in Table No. 26-C.

EXCEPTION: The provisions of this paragraph may be waived when written evidence is submitted by a qualified person showing that the walls meet all the other requirements of this Code.

3. **Design.** The maximum allowable compressive stress in reinforced concrete bearing walls with minimum reinforcement as required by this subsection shall not exceed

$$\left[1-\left(\frac{h}{30d}\right)^3\right] 0.2f'_c \quad \text{.....(17)}$$

When the reinforcement in bearing walls is designed, placed, and anchored in position as for columns, the working stresses shall be on the basis of formulas for columns. For calculating wall stresses, concentrated loads may be assumed to be distributed over a maximum length of wall not exceeding the center to center distance between loads nor five times the width of the bearing.

Reinforced concrete walls shall be reinforced with an area of steel in each direction, both vertical and horizontal, at least equal to 0.0025 times the cross-sectional area of the wall. Walls more than ten inches (10") in thickness shall have the reinforcement for each direction placed in two layers parallel with the faces of the wall. One layer consisting of not less than one-half and not more than two-thirds the total required reinforcement shall be placed not less than one and one-half inches (1½") nor more than one-third the thickness of the wall from the exterior surface. The other layer, comprising the balance of the required reinforcement, shall be placed not less than three-fourths inch (¾") and not more than one-third the thickness of the wall from the interior surface. Bars shall be not less than three-eighths inch (⅜") round, nor shall they be spaced more than eighteen inches (18") on centers.

Reinforced concrete walls shall be anchored at all points of lateral support. Such anchorage shall be capable of resist-

TABLE NO. 26-C—REQUIREMENTS FOR REINFORCED CONCRETE BEARING WALLS

MAXIMUM HEIGHT IN FEET	STORY	LIMITING RATIO—DISTANCE BETWEEN SUPPORTS TO WALL THICKNESS	MINIMUM THICKNESS IN INCHES		
38	3	25	6		
	2		7	6	
	1		7	7	6
	Basement		8	8	8

ing the horizontal forces with a minimum of 200 pounds per lineal foot.

(l) **Non-Bearing Partitions.** Non-bearing partitions of reinforced concrete shall have a thickness of not less than one forty-eighth of the distance between their supports nor less than two inches (2").

Footings

Sec. 2621. (a) **Loads and Reactions.** Footings shall be proportioned to sustain the applied loads and induced reactions without exceeding the allowable stresses as prescribed in Section 2613, and as further provided in this Section and in Sec. 2624 (e) for plain concrete.

In cases where the footing is concentrically loaded and the member being supported does not transmit any moment to the footing, computations for moments and shears shall be based on an upward reaction assumed to be uniformly distributed per unit area or per pile and a downward applied load assumed to be uniformly distributed over the area of the footing covered by the column, pedestal, wall, or metallic column base.

In cases where the footing is eccentrically loaded or the member being supported transmits a moment to the footing, proper allowance shall be made for any variation that may exist in the intensities of reaction and applied load consistent with the magnitude of the applied load and the amount of its actual or virtual eccentricity.

In the case of footings on piles, computations for moments and shears may be based on the assumption that the reaction from any pile is concentrated at the center of the pile.

(b) **Sloped or Stepped Footings.** In sloped or stepped footings, the angle of slope or depth and location of steps shall be such that the allowable stresses are not exceeded at any section.

In sloped or stepped footings, the effective cross section in compression shall be limited by the area above the neutral plane.

Sloped or stepped footings shall be cast as a unit.

(c) **Bending Moment.** The external moment on any section shall be determined by passing through the section a vertical plane which extends completely across the footing, and computing the moment of the forces acting over the entire area of the footing on one side of said plane.

The greatest bending moment required in the design of an isolated footing shall be the moment so computed at sections located as follows:

1. At the face of the column, pedestal or wall, for footings supporting a concrete column, pedestal or wall.
2. Halfway between the middle and the edge of the wall, for footings under masonry walls.
3. Halfway between the face of the column or pedestal and the edge of the metallic base, for footings under metallic bases.

The width resisting compression at any section shall be assumed as the entire width of the top of the footing at the section under consideration.

Footings (Cont'd.)

In one-way reinforced footings, the total tensile reinforcement at any section shall provide a moment of resistance at least equal to the moment computed as specified in this Section, and the reinforcement thus determined shall be distributed uniformly across the full width of the section.

In two-way reinforced footings, the total tensile reinforcement at any section shall provide a moment of resistance at least equal to 85 per cent of the moment computed as specified in this Section, and the total reinforcement thus determined shall be distributed across the corresponding resisting section in the following manner:

In two-way square footings, the reinforcement extending in each direction shall be distributed uniformly across the full width of the footing.

In two-way rectangular footings, the reinforcement in the long direction shall be distributed uniformly across the full width of the footing. In the case of the reinforcement in the short direction, that portion determined by Formula (18) shall be uniformly distributed across a band-width (B) centered with respect to the center line of the column or pedestal and having a width equal to the length of the short side of the footing. The remainder of the reinforcement shall be uniformly distributed in the outer portion of the footing.

$$\frac{\textit{Reinforcement in band-width } (B)}{\textit{Total reinforcement in short direction}} = \frac{2}{(S + 1)} \qquad \text{.....(18)}$$

where "S" is the ratio of the long side to the short side of the footing.

(d) **Shear and Bond.** The critical section for shear to be used as a measure of diagonal tension shall be assumed as a vertical section obtained by passing a series of vertical planes through the footing, each of which is parallel to a corresponding face of the column, pedestal, or wall and located a distance therefrom equal to the depth for footings on soil, and one-half the depth for footings on piles.

Each face of the critical section shall be considered as resisting an external shear equal to the load on an area bounded by said face of the critical section for shear, two diagonal lines drawn from the column or pedestal corners and making 45-degree angles with the principal axes of the footing, and that portion of the corresponding edge or edges of the footing intercepted between the two diagonals.

Critical sections for bond shall be assumed at the same planes as those prescribed for bending moment in Subsection (c); also at all other vertical planes where changes of section or of reinforcement occur.

Computations for shear to be used as a measure of bond shall be based on the same section and loading as specified for the determination of external bending moment in Subsection (c).

The total tensile reinforcement at any section shall provide a bond resistance at least equal to the bond requirement as computed from the following percentages of the external shear at the section:

Footings (Cont'd.)

1. In one-way reinforced footings, 100 per cent.
2. In two-way reinforced footings, 85 per cent.

In computing the external shear on any section through a footing supported on piles, the entire reaction from any pile whose center is located six inches (6") or more outside the section shall be assumed as producing shear on the section; the reaction from any pile whose center is located six inches (6") or more inside the section shall be assumed as producing no shear on the section. For intermediate positions of the pile center, the portion of the pile reaction to be assumed as producing shear on the section shall be based on straightline interpolation between full value at six inches (6") outside the section and zero value at six inches (6") inside the section.

Shearing and bond stresses shall not exceed those specified in Sections 2613, 2617, and 2618.

(e) **Transfer of Stress at Base of Column.** The stress in the longitudinal reinforcement of a column or pedestal shall be transferred to its supporting pedestal or footing either by extending the longitudinal bars into the supporting member, or by dowels.

In case the transfer of stress in the reinforcement is accomplished by extension of the longitudinal bars, they shall extend into the supporting member the distance required to transfer to the concrete, by allowable bond stress, their full working value.

In cases where dowels are used, their total sectional area shall be not less than the sectional area of the longitudinal reinforcement in the member from which the stress is being transferred. In no case shall the number of dowels per member be less than four and the diameter of the dowels shall not exceed the diameter of the column bars by more than one-eighth inch (⅛").

Dowels shall extend up into the column or pedestal a distance at least equal to that specified in Section 2620 (c)-3, for lap of longitudinal column bars and down into the supporting pedestal or footing the distance required to transfer to the concrete, by allowable bond stress, the full working value of the dowel.

The compressive stress in the concrete at the base of a column or pedestal shall be considered as being transferred by bearing to the top of the supporting pedestal or footing. The unit compressive stress on the loaded area shall not exceed the bearing stress allowable for the quality of concrete in the supporting member as limited by the ratio of the loaded area to the supporting area.

Bearing stresses shall not exceed those set forth in Table No. 26-B.

In sloped or stepped footings, the supporting area for bearing may be taken as the top horizontal surface of the footing, or assumed as the area of the lower base of the largest frustum of a pyramid or cone contained wholly within the footing and having for its upper base the area actually loaded, and having side slopes of one vertical to not more than two horizontal.

Footings (Cont'd.)

(f) **Footings Supporting Round Columns.** In computing the stresses in footings which support a round or octagonal concrete column or pedestal, the "face" of the column or pedestal shall be taken as the side of a square having an area equal to the area enclosed within the perimeter of the column or pedestal.

(g) **Minimum Edge-Thickness.** In reinforced concrete footings, the thickness above the reinforcement at the edge shall be not less than six inches (6") for footings on soil, nor less than twelve inches (12") for footings on piles.

Precast Concrete Joists

Sec. 2622. The depth of precast concrete joists shall be not more than four times the width of the top or bottom flanges nor less than one twenty-fourth of the span length.

The thickness of the top slab shall be not less than one-twelfth of the clear span between joists nor less than two inches (2") for roofs or floors and not less than one and one-half inches (1½") over the joists. The slab shall have not less than 0.2 per cent reinforcement at right angles to the span of joists. The reinforcement shall be spaced not farther apart than five times the slab thickness.

When the top slab is adequately reinforced and bonded to the joist, the construction may be considered as a T-beam.

Composite Beams

Sec. 2623. The term "Composite Beam" shall apply to any rolled or fabricated steel floor beam entirely encased in poured concrete at least four inches (4") wider, at its narrowest point, than the flange of the beam, supporting a concrete slab on each side without openings adjacent to the beam; provided that the top of the beam is at least one and one-half inches (1½") below the top of the slab and at least two inches (2") above the bottom of the slab; provided that a good grade of stone or gravel concrete with portland cement is used; and provided that the concrete has adequate mesh, or other reinforcing steel, throughout its whole depth and across the soffit.

Composite beams may be figured on the assumption that:

1. The steel beam carries unassisted all dead loads prior to the hardening of the concrete, with due regard for any temporary support provided.

2. The steel and concrete carry by joint action all loads, dead and live, applied after the hardening of the concrete.

The total tensile unit stress in the extreme fiber of the steel beam thus computed shall not exceed 20,000 pounds per square inch. (See Section 2702).

The maximum stresses in concrete, and the ratio of Young's moduli for steel and concrete, shall be as prescribed by the specifications governing the design of reinforced concrete for the structure.

The web and end connections of the steel beam shall be adequate to carry the total dead and live load without exceeding the unit stresses prescribed in this Code, except as this may be reduced by the provision for other proper support.

Plain Concrete

Plain Concrete

Sec. 2624. (a) **General.** Plain concrete, other than fill, shall have a minimum ultimate compressive strength at 28 days of 2000 pounds per square inch, and material, proportioning, and placing shall conform to the requirements of this Chapter. Concrete made with lightweight aggregates may be used with strengths less than 2000 pounds per square inch if it has been shown by tests or experience to have sufficient strength and durability.

Provisions shall be made to care for temperature and shrinkage stresses either by use of reinforcement or by means of joints.

Plain concrete construction shall conform to the detailed minimum requirements specified in this Chapter. Where Section 2312 is applicable, plain concrete shall also be designed in accordance with the allowable stresses specified in this Chapter.

(b) **Wall Thickness.** The thickness of plain concrete walls may be two inches (2") less than required by Section 2404 for plain masonry walls but in no case less than seven inches (7"), and the ratio of unsupported height or length (whichever is the lesser) to thickness, shall not be greater than 22.

(c) **Design.** Plain concrete walls shall be designed to withstand all vertical and horizontal loads as specified in Chapter 23.

(d) **Stresses.** The allowable working stresses in plain concrete walls shall not exceed the following percentages of ultimate strength:

Compression	$.25\ f'_c$
Tension	$.01\ f'_c$
Shear	$.02\ f'_c$

(e) **Pedestals and Footings (Plain Concrete).** The allowable compressive unit stress on the gross area of a concentrically loaded pedestal shall not exceed $0.25f'_c$. Where this stress is exceeded, reinforcement shall be provided and the member designed as a reinforced concrete column.

The depth and width of a pedestal or footing of plain concrete shall be such that the tension in the concrete shall not exceed $0.03f'_c$, and the average shearing stress shall not exceed $0.02f'_c$ taken on critical sections as determined for reinforced concrete footings. The thickness at the edge shall be not less than eight inches (8") for footings on soil, nor less than fourteen inches (14") above the tops of the piles for footings on piles.

Pneumatically Placed Concrete

Sec. 2625. (a) **General.** For the purpose of this Chapter all pneumatically placed concrete shall consist of a mixture of fine aggregate and cement pneumatically applied by suitable mechanism, and to which water is added immediately prior to discharge from the applicator.

Except as specified in the following subsections of this Section, all pneumatically placed concrete shall conform to the regulations of this Chapter for concrete.

Pneumatically Placed Concrete (Cont'd.)

(b) **Proportions.** The proportion of cement to aggregate, in loose dry volumes, shall be not less than one to four and one-half.

(c) **Water.** The water content at the time of discharge, including any moisture in the fine aggregate, shall not exceed three and one-half gallons per sack of cement.

(d) **Mixing.** The cement and aggregate shall be thoroughly mixed prior to the addition of water. At the time of mixing the fine aggregate shall contain not less than three per cent moisture.

(e) **Rebound.** Any rebound or accumulated loose aggregate shall be removed from the surface to be covered prior to placing the initial or any succeeding layers of pneumatically placed concrete. Rebound may be re-used if it conforms to the requirements for aggregate, but not in excess of 25 per cent of the total aggregate in any batch.

(f) **Joints.** Unfinished work shall not be allowed to stand for more than 30 minutes unless all abrupt edges are sloped to a thin edge. Before resuming work, this sloped portion shall be cleaned and wetted.

(g) **Damage.** Any pneumatically placed concrete which subsides after placement shall be removed.

Bolts

Sec. 2626. Bolts shall be solidly embedded in plain or reinforced concrete, and the connection shall be designed so that the shear on every bolt is not more than the values set forth in Table No. 26-D.

TABLE NO. 26-D—ALLOWABLE SHEAR ON BOLTS

DIAMETER (In Inches)	EMBEDMENT (In Inches)	SHEAR (In Pounds)
½	4	750
⅝	4	1000
¾	5	1500
⅞	6	2000
1	7	2500
1-⅛	8	3000
1-¼	9	3500

CHAPTER 27 — STEEL AND IRON (Quality and Design)

Quality and Design

Sec. 2701. The quality and design of steel and iron used structurally in buildings or structures shall conform to the requirements specified in this Chapter.

Steel used structurally shall be of such quality as to conform to U.B.C. Standard No. 27-1.

Steel used in structural members of light steel shall conform to U.B.C. Standard No. 27-2.

Steel pipe for steel pipe columns shall be of such quality as to conform to U.B.C. Standard No. 27-3, and shall be a medium carbon steel manufactured by the open hearth or electric furnace process.

Cast steel used in buildings or structures shall be of such quality as to conform to U.B.C. Standard No. 27-4.

Cast iron used in buildings or structures shall be of such quality as to conform to U.B.C. Standard No. 27-5.

Rivet steel shall conform to U.B.C. Standard No. 27-6.

Arc-welding electrodes shall conform to the requirements of U.B.C. Standard No. 27-7. Electrodes shall be of Classification Numbers E6010, E6011, E6012, E6013, E6015, E6016, E6020 or E6030 and shall be suitable for the positions and other conditions of intended use.

All structural steel, cast steel and cast iron shall be tested in accordance with the above specifications when deemed necessary by the Building Official and copies of such tests shall be filed in the office of the Building Official. No structural steel, cast steel and cast iron shall be used in any building or structure which does not comply with the above requirements or for which no test results have been filed with the Building Official. All such tests shall be made by competent testing laboratories at the expense of the owner.

The computation and design shall be properly made so that the unit working stresses specified in this Chapter are not exceeded. The structure and its details shall possess the requisite strength and rigidity for proper stability and the design of structural members shall be such as to admit of a rational analysis according to well established principles of mechanics and sound engineering practice.

All structural steel sections shall be straight and true and any section so damaged as to affect its proper carrying capacity shall not be used in the construction of any building or structure.

Allowable Unit Stresses

Sec. 2702. All parts of the structure shall be so proportioned that the sum of the maximum static stresses in pounds per square inch shall not exceed those specified in this Section.

(a) **Tension**

Structural Steel, net section	20,000
Cast Steel on net section	15,000
Cast Iron on net section	(not allowed)
Rivets, on area based on nominal diameter	20,000
Bolts, at root of thread	20,000

Allowable Unit Stresses (Cont'd.)

(b) **Compression**

Columns, gross section

For axially loaded columns with values of l/r

not greater than 120 ..... $17{,}000 - 0.485\frac{l^2}{r^2}$

For axially loaded columns (main members) with values of l/r

greater than 120 $\left\{\frac{18{,}000}{1+\frac{l^2}{18{,}000r^2}}\right\}\left\{1.6-\frac{l}{200r}\right\}$

For axially loaded columns (bracing and other secondary members) with values of l/r

greater than 120 ..... $\frac{18{,}000}{1+\frac{l^2}{18{,}000r^2}}$

Plate Girder Stiffeners, gross section 20,000

Webs of Rolled Sections at toe of fillet 24,000

For main compression members, the ratio of l/r shall not exceed 180 and for bracing, struts and similar members 200.

On cast iron columns, with square or fixed ends;

$P = 9{,}000 - 40\,l/r$

with a minimum gross diameter of six inches (6") and with the ratio l/r never in excess of 70.

In the foregoing formulas P equals the maximum unit working stress in pounds per square inch; l equals the unsupported length of the column or compression member in inches; and r equals the least radius of gyration of the column or compression member.

(c) **Bending.** Tension in extreme fibers of rolled sections, plate girders, and built-up members 20,000

Compressive unit stress in pounds per square inch in the flange of any member resisting flexure shall not exceed the value computed from the following formula:

With $\frac{ld}{bt}$ not in excess of 600 20,000

With $\frac{ld}{bt}$ in excess of 600 ..... $\frac{12{,}000{,}000}{\frac{ld}{bt}}$

in which l is the laterally unsupported length and d the depth of the member; b is the width and t the thickness of its compression flange, all in inches, except that l shall be taken as twice the length of the compression flange of a cantilever beam not fully stayed at its outer end against translation or rotation.

Girders, beams, lintels, and similar members may be laterally braced by joists, tie rods or similar members

anchored thereto so as to laterally stay such members in both directions.

Allowable Unit Stresses (Cont'd.)

On extreme fibers of pins, when the forces are assumed as acting at the center of gravity of the pieces.....30,000

(d) **Shearing**

Rivets, pins, and turned bolts in reamed or drilled holes	15,000
Unfinished bolts	10,000
Webs of beams and plate girders, gross section	13,000

(e) **Bearing**

	Double Shear	Single Shear
Rivets, and turned bolts in reamed or drilled holes	40,000	32,000
Unfinished bolts	25,000	20,000
Pins	32,000	
Contact Area		
Milled stiffeners and other milled surfaces		30,000
Fitted stiffeners		27,000
Expansion rollers and rockers (pounds per linear inch)		600d
in which d is diameter of roller or rocker in inches		

(f) **Reversal of Stress.** The sectional area of the portion between connections, of members subject to reversal of stress, need not be increased by reason of the reversal, but shall be sufficient in area and disposition to provide for the maximum compression, and the maximum tension, separately.

The sectional area of members subject to loads (other than wind loads) producing alternating tensile and compressive stresses shall be augmented, at the approach to a connection, by riveting or welding on additional material, so that the augmented section shall comply with the following rule:

To the net total compressive stress, and to the net total tensile stress, add arithmetically 50 per cent of the smaller of these two; and proportion the connected material and the connecting rivets, bolts, pins or welds, for each of the two increased stresses thus separately obtained at the unit stresses prescribed in this Section.

(g) **Members Carrying Wind Load Only.** (See Section 2307.)

(h) **Allowable Unit Stresses for Used Steel.** The allowable unit stresses assigned by the Building Official to any steel not complying with the requirements of Section 2701 shall in no case be more than 80 per cent of the stresses given in Section 2702. In designs where used steel is provided for, proper allowances shall be made for holes, reduction in section by rust or other defects.

Sec. 2703. Every member and combination of members shall be designed to provide for any stress due to an eccentric load or force, whenever the increase in stress due to eccentric load or force exceeds 10 per cent of the stress due to a

Eccentric Loads

Eccentric Loads (Cont'd.)

direct load or force on the member or members; but a member framed directly to a central web of another member shall not be considered an eccentric load or force in case the resultant of the load or force acts parallel with the said central web.

Rivets, bolts and welds subject to shearing and externally applied tensile or compressive forces shall be so proportioned that the combined unit stress will not exceed the unit stress allowed for shear.

Members subject to both axial and bending stresses shall be so proportioned that the quantity $\frac{f_a}{F_a}+\frac{f_b}{F_b}$ shall not exceed unity, in which

F_a = Axial unit stress that would be permitted by this Code if axial stresses only existed.

F_b = Bending unit stress that would be permitted by this Code if bending stresses only existed.

f_a = Unit axial stress (actual) = the total axial stress divided by the area of the member.

f_b = Unit bending stress (actual) = the bending moment divided by the section modulus of the member.

Beams and Girders

Sec. 2704. (a) **Riveted Plate Girders.** Riveted plate girders, cover-plated beams, and rolled beams shall in general be proportioned by the moment of inertia of the gross section. No deduction shall be made for standard shop or field rivet holes in either flange; (except that in special cases where the reduction of the area of either flange by such rivet holes, calculated in accordance with the provisions of Section 2707, exceeds 15 per cent of the gross flange area, the excess shall be deducted.) If such members contain other holes, as for bolts, pins, or countersunk rivets, the full deduction for such holes shall be made. The deductions thus applicable to either flange shall be made also for the opposite flange if the corresponding holes are there present. When two or more rolled beams or channels are used to form a girder they shall be so connected to each other as properly to distribute the loads to be carried.

(b) **Plate Girder Webs.** Plate girder webs shall have a thickness of not less than 1/170 of the unsupported distance between flanges.

(c) **Web Splices in Plate Girders.** Web splices in plate girders shall be proportioned to transmit the full shearing and bending stresses in the web at the point of splice.

If the flanges are spliced, the splices shall either develop the full effective strength of the material or they shall develop the strength required by the total stresses, but in no case shall the strength developed be less than 50 per cent of the effective strength of the material spliced, nor shall butt-welded joints be only partially welded.

(d) **Stiffeners.** Stiffeners shall be placed on the webs of plate girders at the ends and at points of concentrated loads. They shall have a close bearing against the flanges,

shall extend as closely as possible to the edges of the flange angles, and shall not be crimped. They shall be connected to the web by enough rivets to transmit the stress. Only that portion of the outstanding legs outside the fillets of the flange angles shall be considered effective in bearing.

If $\frac{h}{t}$ is equal to or greater that 70, intermediate stiffeners shall be required at all points where v exceeds $\frac{64{,}000{,}000}{\left(\frac{h}{t}\right)^2}$

WHERE

h = clear depth between flanges, in inches.

t = thickness of the web, in inches.

v = greatest unit shear in panel, in pounds per square inch under any condition of complete or partial loading.

The clear distance between stiffeners, when stiffeners are required by the foregoing, shall not exceed eighty-four inches (84″) or that given by the formula:

$$d = \frac{11{,}000\,t}{\sqrt{v}}$$

in which d equals the clear distance between stiffeners, in inches.

Plate girder stiffeners shall be in pairs, one on each side of the web, and shall be connected to the web by rivets spaced not more than eight times their nominal diameter apart.

Intermediate stiffeners may be crimped over the flange angles.

(e) **Crane Runway Horizontal Forces.** The lateral force on crane runways to provide for the effect of moving crane trolleys shall, if not otherwise specified, be 20 per cent of the sum of the weights of the lifted load and of the crane trolley (but exclusive of other parts of the crane), applied at the top of rail one-half on each side of runway; and shall be considered as acting in either direction normal to the runway rail.

The longitudinal force shall, if not otherwise specified, be taken as 10 per cent of the maximum wheel loads of the crane applied at the top of rail.

(f) **Flange Connections.** Rivets and welds connecting the flanges to the web shall be proportioned to resist the horizontal shear due to bending as well as any loads applied directly to the flange.

(g) **Flanges.** The thickness of outstanding parts of flanges shall conform to the requirements of Section 2705 (b).

Unstiffened cover plates on riveted girders shall not extend more than 16 times the thickness of the thinnest outside plate beyond the outer row of rivets connecting them to the angles. The total cross-sectional area of cover plates of riveted girders shall not exceed 70 per cent of the total flange area.

Beams and Girders (Cont'd.)

If the girder is subjected to substantial fluctuations in loading, stiffeners, lateral plates or other appurtenant material shall not be welded to the tension flange, except at points where the maximum flange stress is less than half the allowable.

(h) **Cover Plates.** Cover plates, when required, shall be of equal thickness or shall diminish in thickness from the flange angles outward. No plate shall be thicker than the flange angles.

(i) **Flange Sections.** The gross section of the compression flange of a plate girder shall be not less than the gross section of the tension flange.

(j) **Rolled Beams.** Rolled beams shall be so proportioned that the unit compression stresses at the web toe of the fillets resulting from concentrated loads shall not exceed 24,000 pounds. Such stresses shall be determined by the formulas:

$$\text{For interior loads } \frac{R}{t\ (N + 2k)} = \text{not over } 24{,}000$$

$$\text{For end-reactions } \frac{R}{t\ (N + k)} = \text{not over } 24{,}000$$

WHERE

R = concentrated interior load or end reaction in pounds.

t = thickness of web, in inches.

N = length of bearing, in inches.

k = distance from outer face of flange to web toe of fillet, in inches.

(k) **Effective Span Length.** Beams, girders and trusses shall ordinarily be designed on the basis of simple spans whose effective length is equal to the distance between centers of gravity of the members to which they deliver their end reactions.

If, on the assumption of end restraint, full or partial, based on continuous or cantilever action, beams, girders, and trusses are designed for a shorter effective span length than that specified in the paragraph above, their sections, as well as the sections of the members to which they connect, shall be designed to carry the shears and moments so introduced, in addition to all other forces, without exceeding at any point the unit stresses specified in Section 2702.

Thickness of Materials

Sec. 2705. (a) **Thickness of Material.** The minimum thickness of metal in structural steel shapes shall be: for sections exposed to the weather five-sixteenths inch (5/16"); for interior construction one-quarter inch (¼"); and shall be not less than one-half inch (½") at every point for any cast iron or cast steel member, except as follows:

EXCEPTIONS: 1. The webs of channels and I-beams, the edges of rolled steel sections, steel joists, signs, skylight bars, non-bearing walls and partitions, suspended ceilings, cornice brackets, steel studs, and similar steel shapes shall

not be limited to the above thickness requirements except as provided in Section 2715. **Thickness of Materials (Cont'd.)**

2. In steel trusses carrying roof loads only on buildings not exceeding two stories in height, the minimum thickness of metal shall be three-sixteenths inch (3/16″).

3. Steel floor and wall panels shall not be limited by the above thickness requirements, but shall be not less than 18 gauge.

(b) **Projecting Elements Under Compression.** Projecting elements of members subjected to axial compression or compression due to bending shall have ratios of width to thickness not greater than the following:

Single-angle struts	12
Double-angle struts, angles or plates projecting from girders, columns or other compression members; compression flanges of beams; stiffeners on plate girders; flanges or stems of tees	16

The width of plates shall be taken from the free edge to the first row of rivets or welds; the width of legs of angles, channels and zees, and of the stems of tees, shall be taken as the full nominal dimension; the width of flanges of beams and tees shall be taken as one-half the full nominal width. The thickness of a sloping flange shall be measured halfway between a free edge and the corresponding face of the web.

When a projecting element exceeds the width-to-thickness ratio prescribed in the preceding paragraph, but would conform to same and would satisfy the stress requirements with a portion of its width considered as removed, the member will be considered acceptable without the actual removal of the excess width.

Sec. 2706. Compression members when faced for bearings shall be spliced sufficiently to hold the connected members accurately in place. Other joints in riveted work, whether in tension or compression, shall be spliced so as to transfer the stress to which the member is subject. **Compression Splices**

Sec. 2707. (a) **Riveted Holes.** In computing net area the diameter of a rivet hole shall be taken as one-eighth inch (⅛″) greater than the nominal diameter of the rivet. **Gross and Net Sections**

(b) **Pin Holes.** In pin connected tension members, the net section across the pin hole, transverse to the axis of the member, shall be not less than 135 per cent and the net section beyond the pin hole, parallel with the axis of the member, not less than 90 per cent, of the net section of the body of the member.

In all pin connected riveted members the net width across the pin hole, transverse to the axis of the member, shall preferably not exceed eight times the thickness of the member at the pin.

(c) **Chain of Holes.** In the case of a chain of holes extending across a part in any diagonal or zigzag line, the net width of the part shall be obtained by deducting from the gross width the sum of the diameters of all the holes in

Gross and Net Sections (Cont'd.)

the chain, and adding to the section so obtained for each gauge space in the chain, the quantity $\frac{s^2}{4g}$

WHERE

s = longitudinal pitch of any two successive holes

g = transverse gauge of the same two holes.

The critical net section of the part is obtained from the chain which gives the least net width.

(d) **Gross Width of Angles.** For angles, the gross width shall be the sum of the widths of the legs less their thickness. The gauge for the holes in opposite legs shall be the sum of the gauges from back of angle less the thickness.

(e) **Splice Members.** For splice members, the thickness shall be only that part of the thickness of the member which has been developed by rivets beyond the section considered.

(f) **Designed Sections.** Unless otherwise specified, tension members shall be designed on the basis of net section. Columns shall be designed on the basis of gross section. Beams and girders shall be designed as specified in Section 2704.

In determining the net section across plug or slot welds, the weld metal shall not be considered as adding to the net area.

Connections

Sec. 2708. (a) **Minimum Number of Rivets.** Connections carrying calculated stresses, except for lacing, sag bars and girts, shall have not fewer than two rivets.

(b) **Eccentricity in Members.** Members meeting at a joint shall have their gravity axis meet at a point if practicable; if not, provision shall be made for their eccentricity.

(c) **Eccentricity in Rivets.** The rivets at the ends of a member transmitting stresses into that member should have their centers of gravity on the line of the center of gravity of the member; if not, provision shall be made for the effect of the resulting eccentricity. Pins may be so placed as to counteract the effect of bending due to dead load.

(d) **Eccentricity in Angles.** Where angles in tension are connected through but one leg and the eccentricity is not taken into account, only 80 per cent of the net section of the angle shall be considered as effective.

(e) **Eccentricity in Members in Flexure.** When beams, girders or trusses are designed on the basis of simple spans, their end connections may ordinarily be designed for the reaction shears only. If, however, the eccentricity of the connection is excessive, provision shall be made for the resulting moment.

(f) **Combined Shear and Moment.** When beams, girders or trusses are subject both to reaction shear and end moment, due to full or partial end restraint, based on continuous or cantilever action, their connections shall be especially designed to carry both shear and moment without exceeding at any point the unit stresses specified in Section 2702.

TABLE NO. 27-A—MINIMUM EDGE DISTANCES

RIVET DIAMETER (Inches)	MINIMUM EDGE DISTANCE (INCHES) FOR PUNCHED HOLES		
	In Sheared Edge	In Rolled Edge of Plates	In Rolled Edge of Structural Shapes
½	1	⅞	¾*
⅝	1⅛	1	⅞*
¾	1¼	1⅛	1 *
⅞	1½	1¼	1⅛*
1	1¾	1½	1¼*
1⅛	2	1¾	1½*
1¼	2¼	2	1¾*

*May be decreased ⅛ inch when holes are near end of beam.

Ordinary end connections comprising only a pair of web angles, with not more than nominal seat and top angle, shall not be assumed to provide for this kind of end moment.

(g) **Filler Plates.** When rivets carrying computed stress pass through fillers, the fillers shall be extended beyond the connected member and the extension secured by sufficient rivets to develop the strength of the filler.

(h) **Fillers Under Stiffeners.** Fillers under plate girder stiffeners at end bearing or points of concentrated loads shall be secured by sufficient rivets to prevent excessive bending and bearing stresses.

(i) **Riveted Joints.** All joints in riveted work, whether in tension or compression, shall be so spliced as properly to transmit all stresses, except as specified in Section 2706.

The minimum distance from the center of any rivet or bolt hole to any edge shall be as set forth in Table No. 27-A.

The minimum distance between centers of rivet holes shall be three diameters of the rivet.

The maximum pitch in the line of stress of compression members composed of plates and shapes shall not exceed 16 times the thinnest outside plate or shape, or 20 times the thinnest enclosed plate or shape with a maximum of twelve inches (12″); and at right angles to the direction of stress the distance between lines of rivets shall not exceed 32 times the thinnest plate or shape. For angles in built sections with two gauge lines, with rivets staggered, the maximum pitch in the line of stress in each gauge line shall not exceed 24 times the thinnest plate with a maximum of eighteen inches (18″).

In tension members composed of two angles, a pitch of three feet six inches (3′6″) will be allowed, and in compression members two feet (2′) but the ratio l/r for each angle between rivets shall be not more than three-fourths of that of the whole member.

The pitch of rivets at the ends of built-up compression members shall not exceed four diameters of the rivets for a length equal to one and one-half times the maximum width of the member.

The minimum distance between the center of any rivet under computed stress, and the end or other boundary of the

connected member toward which the pressure of the rivet is directed, shall be not less than the shearing area of the rivet shank (single or double shear respectively) divided by the plate thickness. This end distance may, however, be decreased in such proportion as the stress per rivet is less than that specified in Section 2702; and the requirement may be disregarded in case the rivet in question is one of three or more in a line parallel to the direction of the stress.

Rivets and Bolts

Sec. 2709. In proportioning rivets, the nominal diameter of the rivet shall be used.

Rivets carrying calculated stresses, whose grip exceeds five diameters, shall have their number increased one per cent for each additional one-sixteenth inch (1/16″) in the rivet grip. Special care shall be used in heating and driving such rivets.

Rivets shall be used for the connections of main members carrying live loads which produce impact, and for connections subject to reversal of stresses.

Unfinished bolts may be used in shop or field work for connections in small structures used for shelters, and for secondary members of all structures such as purlins, girts, door and window framing, alignment bracing and secondary beams in floor.

The effective bearing area of pins, bolts, and rivets shall be the diameter multiplied by the length in bearing; except that for countersunk rivets, half the depth of the countersink shall be deducted.

Rivets shall be used in the following cases:

In all connections in structures over one hundred feet (100′) in height when the height is more than two and one-half times the minimum horizontal dimension at the ground line.

In all connections in structures one hundred feet (100′) or less in height where the height is more than four times the least horizontal dimension at the ground line.

In all connections of beams and girders to columns and of beams and girders bracing columns in buildings over one hundred feet (100′) in height, and in column splices of buildings more than two hundred feet (200′) in height.

In all connections for supports of machinery or other moving loads.

Unfinished bolts may be used for connections not mentioned in the preceding paragraphs.

Turned bolts in reamed holes may be used, in place of rivets, in either shop or field work where it is impracticable to obtain satisfactory power-driven rivets, provided holes are as specified in Section 2717. The finished shank shall be long enough to provide a full grip for the nut, and washers shall be used under all nuts.

The end reaction stresses of trusses, girders, or beams, and the axial stresses of tension or compression members which are carried on rivets, shall have such stresses developed by the shearing and bearing values of the rivets or bolts.

Welded Connections

Sec. 2710. Fusion welding may be used (in place of riveting or bolting) for connecting structural steel or wrought iron parts or members to one another, but in no case shall the stresses in such joints exceed the allowable unit working stresses given in the following table:

Allowable Unit Working Stresses for Static Loads

Tension in weld metal (butt welds)	20,000 lbs. per sq. in.
Shear in weld metal	13,600 lbs. per sq. in.
Compression in weld metal	20,000 lbs. per sq. in.

Maximum fiber stresses due to bending shall not exceed the values prescribed above for tension and compression, respectively. In designing welded joints adequate provision shall be made for bending stresses due to eccentricity, if any, in the disposition or section of base metal parts.

The same proportional increase in the above working stresses shall be allowed for the various given conditions as specified in Section 2702, Subsections (f) and (g).

U.B.C. Standard No. 27-8 shall be followed in the design and execution of structural welding.

Construction Details

Sec. 2711. Trusses shall be riveted or welded structures and only when there is sufficient reason to justify, as where riveted field connections become unwieldy, may they be designed as pin-connected structures.

All joints in riveted work, whether in tension or compression, shall be spliced properly to transmit the stresses.

Bracing shall be sufficient to withstand safely wind and other forces when the building is in the process of erection as well as after completion.

When two or more plates are in contact they shall be stitch riveted with rivets not more than twelve inches (12") apart in either direction.

The ends of beams, channels, girders and trusses that bear on masonry or reinforced concrete shall be so framed that the allowable stresses for masonry or reinforced concrete shall not be exceeded, and anchors of ample size and strength shall be provided thoroughly embedded in the masonry or reinforced concrete construction.

The ends of all beams, channels, girders, girts, purlins and similar members, that meet on a beam, girder, truss, column or pier shall be connected to each other by a strap or through the carrying members with not less than two bolts or rivets each not less than five-eighths inch (⅝") in diameter in the end of each connecting member.

Tie rods shall be proportioned to resist their respective stresses, and holes for them shall be placed as near the spring of the arches as practicable.

Lacing

Sec. 2712. (a) **Compression Members.** The open sides of compression members shall be provided with lacing having tie plates at each end and at intermediate points if the lacing is interrupted. Tie plates shall be as near the ends as practicable. In main members carrying calculated stresses the end tie plates shall have a length of not less than the distance between the lines of rivets connecting them to the flanges, and intermediate ones of not less than one-half of this distance. The thickness of tie plates shall be not less than

Lacing (Cont'd.)

one-fiftieth of the distance between the lines of rivets connecting them to the segments of the members, and the rivet pitch shall be not more than six diameters and the tie plates shall be connected to each segment by at least three rivets. In welded construction, the welding on each line connecting a tie plate shall aggregate not less than one-third the length of the plate.

(b) **Tension Members.** Tie plates shall be used to secure the parts of tension members composed of shapes. They shall have a length not less than two-thirds of the length specified for tie plates in compression members. The thickness shall be not less than one-fiftieth of the distance between the lines of rivets connecting them to the segments of the member and they shall be connected to each segment by at least three rivets.

(c) **Spacing of Lacing Bars.** Lacing bars of compression members shall be so spaced that the ratio l/r of the flange included between their connections shall be not over three-fourths of that of the member as a whole.

(d) **Proportioning of Lacing Bars.** Lacing bars shall be proportioned to resist a shearing stress normal to the axis of the member equal to two per cent of the total compressive stress of the member. In determining the section required the compression formula shall be used, l being taken as the length of the bar between the outside rivets connecting it to the segment for single lacing and 70 per cent of that distance for double lacing. The ratio l/r shall not exceed 140 for single lacing and 200 for double lacing.

(e) **Thickness of Lacing Bars.** The thickness of lacing bars shall be not less than one-fortieth for single lacing and one-sixtieth for double lacing of the distance between end rivets; their minimum width shall be three times the diameter of the rivets connecting them to the segments.

(f) **Inclination of Lacing Bars.** The inclination of lacing bars to the axis of the members shall preferably be not less than 45 degrees for double lacing and 60 degrees for single lacing. When the distance between rivet lines in the flanges is more than fifteen inches (15") the lacing shall be double and riveted at the intersection if bars are used, or else shall be made of angles.

Pins and Pin Holes

Sec. 2713. Pins shall be long enough to insure a full bearing of all parts connected upon the turned-down body of the pin.

Members packed on pins shall be held against lateral movement.

Pin holes shall be reinforced by plates wherever necessary to give proper bearing. At least one plate shall be as wide as the projecting flanges will allow. Where angles are used this plate shall contain sufficient rivets to distribute their portion of the pin pressure to the full cross section of the member.

Bearing Plates and Anchorage

Sec. 2714. Provision shall be made to transfer the column loads to the footings and foundations.

Column bases shall be set level and to correct elevation with full bearing on the masonry.

Bearing Plates and Anchorage (Cont'd.)

Column bases shall be finished to accord with the following requirements:

1. Rolled steel bearing plates two inches (2") or less in thickness may be used without planing or straightening; rolled steel bearing plates over two inches (2") but less than four inches (4") in thickness may be straightened by pressing, or planed on all bearing surfaces if presses are not available; rolled steel bearing plates four inches (4") or over in thickness shall be planed on all bearing surfaces (except as noted under paragraph 3 of this Section).

2. Column bases other than rolled steel bearing plates shall be planed on all bearing surfaces (except as noted in paragraph 3).

3. The bottom surfaces of column bases which rest on masonry foundations and are grouted to insure full bearing contact need not be planed.

4. Anchor bolts shall be of sufficient size and number to develop the computed stresses.

Light Steel Construction

Sec. 2715. (a) **General.** Steel studs, steel joists and other supports used in the structural frame of light steel construction, shall be light weight rolled sections, or sections made of commonly accepted or specially formed light gauge flat rolled sheets; or a combination of both used alone or in combination with other materials of construction. Such studs, supports or steel joists may be of a determinate truss design with elements effectively joined together by arc or resistance welding, or by rivets. In the case of expanded sections, a portion of the metal may be left intact to form a connection. For steel studs the ratio of l/r shall not exceed 180.

U.B.C. Standard No. 27-9 shall be accepted as recognized engineering practice for the design of light steel structural members, except as otherwise specifically provided in this Code.

Open web or trussed members shall be so constructed that the lines of force of all connected members shall intersect at a point or proper allowance shall be made in the design for any resulting stress. The web elements shall be of sufficient strength to resist effectively the shearing stresses.

The following are the minimum thicknesses of metal permitted for various members of the structural frame of light steel construction:

Bearing studs, floor and roof framing members—16 gauge.

Roof decks supported on ribs—20 gauge.

(For steel floor and wall panel thickness, see Section 2705.)

All connections shall be riveted, bolted or welded. All steel work, including welds and connections, except where entirely encased in concrete, shall be thoroughly cleaned and given one coat of acceptable metal protection well worked into the joints and open spaces.

(b) **Stresses.** The unit design stress in structural members of light steel shall not exceed the minimum yield strength of

Light Steel Construction (Cont'd.)

the steel divided by 1.85. For steel conforming to Grade C (minimum yield point 33,000 pounds per square inch) of U.B.C. Standard No. 27-2 the maximum working stress shall not exceed 18,000 pounds per square inch. Steel of higher strength than Grade C shall be suitably identified as to yield point and ultimate strength.

(c) **Construction Details.** Steel studs or other steel supporting members used in the structural frame of light steel construction and steel joists shall be connected to the supporting beams, girders, foundations or other steel supporting members by arc or resistance welding, riveting, bolting or other approved methods. All such welds in light steel construction shall be made on two sides or two edges of each bearing in such a manner as to resist effectively the stresses developed. Resistance welding shall develop the full strength of the member welded.

Steel floor and roof members supported on masonry and reinforced concrete shall have end bearings at least four inches (4") in length and the ends of such members resting on masonry or reinforced concrete shall be provided with approved joist anchors thoroughly embedded therein.

Bearing plates, when required by design, shall be securely welded, bolted or riveted to such floor and roof members, studs or other supporting members.

Bearing studs or other vertical bearing members shall rest on a sole or plate having an effective width equal to the depth of such member and having a sufficient cross section to transfer the required loads of the vertical member resting thereon unless such bearing vertical member is thoroughly embedded in the concrete foundation. Such soles or plates shall be effectively anchored to the foundation.

When bearing studs or other vertical bearing members are spliced, the full strength of such members shall be developed in the splice.

Where studs do not continue full length from one story through the next story above, a cap plate or steel member shall be provided on top of the lower story studs or a sill plate on the upper story. Such cap plate or sill plate shall be of sufficient strength to distribute adequately the loads from the upper story studs to the lower story studs.

All horizontal or diagonal ties or bracing in exterior walls and bearing partitions shall be effectively arc welded, bolted or riveted to the structural frame or effectively anchored to supporting masonry.

Where plumbing, heating or other pipes or conduits are placed in or partly in an exterior wall or bearing partition necessitating the cutting of soles or plates, bracing or structural member in said wall, such members shall be reinforced so as to provide sufficient strength to resist the stresses imposed thereon or proper provisions shall be made to transfer such stresses to the points of support.

Expansion

Sec. 2716. Proper provision shall be made for expansion and contraction.

Workmanship

Sec. 2717. All workmanship shall be equal to the best practice in modern structural shops.

Drifting to enlarge unfair holes shall not be permitted. Holes that must be enlarged to admit the rivets shall be reamed. Poor matching of holes shall be cause for rejection.

All material shall be clean and straight. If straightening or flattening is necessary, it shall be done by a process that will not injure the material. Sharp kinks or bends shall be cause for rejection.

Rolled sections, except for minor details, shall preferably not be heated, or, if heated shall be annealed.

All steel castings shall be properly annealed.

Material may be punched one-sixteenth inch (1/16") larger than the nominal diameter of the rivets, whenever the thickness of the metal is equal to or less than the diameter of the rivets, plus one-eighth inch (⅛"). When the metal is thicker than the diameter of the rivet, plus one-eighth inch (⅛"), the holes shall be drilled, or sub-punched and reamed.

Holes for shop turned bolts shall be sub-punched and reamed or drilled from the solid. Holes for field turned bolts shall be sub-punched in the shop and reamed in the field.

When sub-punching and reaming is required the die used for punching shall be one-sixteenth inch (1/16") smaller than the nominal diameter of the rivet. Rivet holes, after assembling, shall be reamed to a diameter one-sixteenth inch (1/16") greater than the nominal diameter of the rivet. Turned bolt holes, after assembling, shall be reamed (for field bolts in the field) to a diameter one-fiftieth inch (1/50") larger than the diameter of the turned bolt.

Rivets are to be driven hot, and, wherever practicable, by power. Rivet heads shall be of hemispherical shape and uniform in size throughout the work for the same size rivet, full, neatly finished, and concentric with the holes. Rivets, after driving, shall be tight, completely filling the holes, and with heads in full contact with the surface.

Rivets shall be heated uniformly to a temperature not exceeding 1950° F. They shall not be driven after their temperature is below 1000° F. Loose, burned and otherwise defective rivets shall be replaced.

Compression joints depending upon contact bearing shall have the bearing surfaces truly faced after the members are riveted. All other joints shall be cut or dressed true and straight.

Finished members shall be true to line and free from twists, bends and open joints.

Compression members may have a lateral variation not greater than 1/1000 of the axial length between points which are to be laterally supported.

An allowable variation of one thirty-second inch (1/32") is permissible in the overall length of members with both ends milled.

Members without milled ends which are framed to other steel parts of the structure may have a variation from the detailed length not greater than one-sixteenth inch (1/16") for members thirty feet (30') or less in length, and not greater than one-eighth inch (⅛") for members over thirty feet (30') in length.

Workmanship (Cont'd.)

Planing or finishing of sheared plates or shapes will not be required unless specifically called for on the drawings.

All parts of riveted members shall be well pinned or bolted and rigidly held together while riveting. Drifting done during assembling shall not distort the metal or enlarge the holes.

Gas cutting may be done under the following conditions:

1. The contractor shall be required to satisfy the Building Official as to his ability to produce satisfactory gas cuts.

2. Gas cut edges shall be regular in contour.

3. Gas cutting may be used in the preparation of base metal parts for welding, provided the edges so cut are thoroughly cleaned after cutting so as to expose clean metal.

4. Gas cutting shall not be permitted to replace the milling of surfaces specified elsewhere in this Code.

5. Gas cutting shall not be permitted on any member while it is carrying stress. To determine the net area of members so cut, one-eighth inch (⅛") shall be deducted from the gas cut edges. The radius of re-entrant gas cut fillets shall be as large as possible, but never less than one inch (1"). This restriction shall not apply to detail cutting for the correction of minor fabricating errors, where the removal of metal resulting from such gas cutting would not reduce the required strength of the member that is to be cut.

6. Gas cutting of holes in any member which has not been designed therefor shall not be permitted.

Painting

Sec. 2718. Parts not in contact, but inaccessible after assembling, shall be properly protected by paint.

All steel work, except where entirely encased in concrete, shall be thoroughly cleaned and given one coat of approved metal protection well worked into the joints and open spaces.

Machine finished surfaces shall be protected against corrosion.

Cast iron columns shall not be painted until after acceptance by the Building Official.

PART VII

DETAILED REGULATIONS

CHAPTER 28 — EXCAVATIONS, FOUNDATIONS AND RETAINING WALLS

Excavations

Sec. 2801. Excavations for buildings and excavations accessory thereto shall be protected and guarded against danger to life and property. Permanent excavations shall have retaining walls of masonry or concrete of sufficient strength to retain the embankment together with any surcharged loads. No excavation for any purpose shall extend within one foot (1′) of the angle of repose or natural slope of the soil under any footing or foundation, unless such footing or foundation is first properly underpinned or protected against settlement.

Any person making or causing an excavation to be made to a depth of twelve feet (12′) or less, below the grade, shall protect the excavation so that the soil of adjoining property will not cave in or settle, but shall not be liable for the expense of underpinning or extending the foundation of buildings on adjoining properties where his excavation is not in excess of twelve feet (12′) in depth. Before commencing the excavation the person making or causing the excavation to be made shall notify in writing the owners of adjoining buildings not less than 10 days before such excavation is to be made that the excavation is to be made and that the adjoining buildings should be protected. The owners of the adjoining properties shall be given access to the excavation for the purpose of protecting such adjoining buildings.

Any person making or causing an excavation to be made exceeding twelve feet (12′) in depth below the grade, shall protect the excavation so that the adjoining soil will not cave in or settle, and shall extend the foundation of any adjoining buildings below the depth of twelve feet (12′) below grade at his own expense. The owner of the adjoining buildings shall extend the foundations of his buildings to a depth of twelve feet (12′) below grade at his own expense as provided in the preceding paragraph.

Soil Classification

Sec. 2802. (a) **General.** The classification of the soil under all portions of every building shall be based upon the examination of adequate test borings or excavations made at the site when required by the Building Official. The location of the test borings or excavations and the nature of the subsurface materials shall be indicated on the plans.

EXCEPTION: Certain buildings of Type V construction may have footings and foundations designed in accordance with the provisions of Section 2204 and Table No. 22-A.

(b) **Moisture Content.** Due allowance shall be made in determining the capacity or sub-surface materials for the effect of possible change in moisture content.

TABLE NO 28-A—ALLOWABLE SOIL PRESSURE
(Pounds per Square Foot)

CLASS OF MATERIAL	MINIMUM DEPTH OF FOOTING BELOW ADJACENT VIRGIN GROUND	VALUE PERMISSIBLE IF FOOTING IS AT MINIMUM DEPTH. POUNDS PER SQUARE FOOT	INCREASE IN VALUE FOR EACH FOOT OF DEPTH THAT FOOTING IS BELOW MINIMUM DEPTH. POUNDS PER SQUARE FOOT	MAXIMUM VALUE. POUNDS PER SQUARE FOOT
1	2	3	4	5
Rock	0′ 0″	20% of ultimate crushing strength	0	20% of ultimate
Compact coarse sand	1′ 0″	1500*	300*	8000
Compact fine sand	1′ 0″	1000*	200*	8000
Loose sand	2′ 0″	500*	100*	3000
Hard clay or sandy clay	1′ 0″	4000	800	8000
Medium stiff clay or sandy clay	1′ 0″	2000	200	6000
Soft sandy clay or clay	2′ 0″	1000	50	2000
Adobe	1′ 6″	1000**	50	
Compact inorganic sand and silt mixtures	1′ 0″	1000	200	4000
Loose inorganic sand and silt mixtures	2′ 0″	500	100	1000
Loose organic sand and silt mixtures and muck or bay mud	0′ 0″	0	0	0

*These values are for footings one foot in width and may be increased in direct proportion to the width of the footing to a maximum of three times the designated value.
**For depths greater than eight feet (8′) use values given for clay of comparable consistency.

(c) **Unequal Loads.** Where footings are to be placed at varying elevations the effect of adjacent loads shall be included in the foundation analysis.

Allowable Soil Pressures

Sec. 2803. The allowable unit soil pressure upon every footing shall not exceed the values as set forth in Table No. 28-A.

EXCEPTION: The tabulated values may be modified as prescribed in Section 2804.

Soil Requirements

Sec. 2804. (a) Requirements. Whenever, in the opinion of the Building Official, the adequacy and class of a soil cannot be determined by the test borings or excavations required by the provisions of Section 2802 (a), he may require a special soil investigation before approving the use of the footing.

(b) **Deviations. Deviations from the allowable unit soil** pressures set forth in Table No. 28-A shall be permitted only after performance of a special soil investigation by an agency acceptable to the Building Official. The Building Official may approve such deviations only after receiving a written opinion from the investigating agency together with substantiating evidence.

(c) **Stresses. Where the bearing capacity of the soil is not** definitely known or is in question, the Building Official may require load tests or other adequate proof as to the permissible safe bearing capacity at that particular location. To determine the safe bearing capacity of soil it may be tested by loading an area not less than two square feet (2 sq. ft.) to not less than twice the maximum bearing capacity desired for use. Such load shall be sustained by the soil until no additional settlement takes place for a period of not less than 48 hours in order that such desired bearing capacity may be used. Examination of sub-soil conditions may be required when deemed necessary.

Design of Footings

Sec. 2805. (a) Footings and Foundations. Footings and foundations, unless specifically provided, shall be constructed of masonry or concrete and shall in all cases extend below the frost line. Footings shall be designed to minimize differential settlement. Mortar used in foundation walls and footings shall be as specified in Section 2403 (e).

Bearing walls shall be supported on continuous solid masonry or concrete footings or piles, which shall be of sufficient size to support safely the loads imposed as determined from the character of the soil. Foundation walls supporting wood shall extend at least six inches (6″) above the finished grade adjacent to the wall at all points. Mudsills shall be bolted to the foundation or foundation wall with not less than one-half inch (½″) bolts, embedded at least seven inches (7″) into the masonry and spaced not more than six feet (6′) apart.

EXCEPTIONS: 1. Interior bearing walls in one-story buildings may be supported on piers.

2. For Type V buildings, (except Group H and I occupancies) isolated piers of solid masonry or concrete may be used for post and girder construction.

XXXX

Design of Footings (Cont'd.)

TABLE NO. 28-B—MINIMUM FOUNDATION REQUIREMENTS FOR STUD BEARING WALLS

Number of Stories	Thickness of Foundation Wall in Inches		Width of Footing in Inches	Thickness of Footing in Inches	Depth of Foundation Below Natural Surface of Ground and Finish Grade in Inches
	Concrete	Unit Masonry			
1	6	6	12	6	12
2	8	8	15	7	18
3	10	10	18	8	24

Where unusual conditions or frost conditions are found, footings and foundations shall be as required in Section 2805 (a).

Note: The ground under the floor may be excavated to the elevation of the top of the footing.

3. A one-story building (except a Group I occupancy) which does not exceed four hundred square feet (400 sq. ft.) in area, including additions, may be constructed without a masonry or concrete foundation if the walls are supported on a wood mudsill.

Mudsills shall be all-heart cedar, all-heart cypress or Foundation Grade redwood, or any species of wood if treated under pressure with an approved preservative.

Minimum foundation requirements for stud bearing walls shall be as set forth in Table No. 28-B.

Foundations for all buildings where the surface of the ground slopes more than one foot (1') in ten feet (10') shall be level or shall be stepped so that both top and bottom of such foundation are level.

(b) **Structural Design.** Except for special provisions of Section 2807, covering the design of piles, all portions of footings shall be designed in accordance with the structural provisions of this Code.

Grillage Footings

Sec. 2806. When grillage footings of structural steel shapes are used on soils, they shall be completely embedded in concrete with at least six inches (6") on the bottom and at least four inches (4") at all other points.

Piles

Sec. 2807. (a) **General.** The allowable axial and lateral loads on piles shall be determined by an approved formula, by load tests, or by a foundation investigation by an approved agency. A foundation investigation shall be made if required by the Building Official.

(b) **Allowable Loads.** 1. **Axial Loads.** The allowable axial load on a pile shall not exceed the value given by the following formulas unless such load is otherwise determined as specified in Section 2804.

Allowable Axial Load $= R/4$ for all piles.

Piles: (Cont'd.)

WHERE

$$R \text{ (for steel piles)} = \frac{12\ Wh\dfrac{W + 0.25P}{W + P}}{S + \dfrac{RL\ 24{,}000}{AE}}$$

$$R \text{ (for other piles)} = \frac{12\ Wh\dfrac{W + 0.1P}{W + P}}{S + \dfrac{RL\ 24{,}000}{AE}}$$

WHERE

R = ultimate driving resistance, in tons.
W = weight of striking parts, in tons.
h = height of fall of striking parts, in feet.
Wh = striking energy, in foot tons.
P = weight of pile, in tons.
S = permanent settlement of pile under the average of the last 10 blows, in inches.
L = length of pile, in feet.
A = average right cross-sectional area of pile material, in square inches.
E = modulus of elasticity of pile, in pounds per square inch.

2. **Group Action.** Consideration shall be given to the reduction of allowable pile load when piles are driven in groups, where soil conditions make such load reductions advisable or necessary, the allowable axial load determined for a single pile shall be reduced by any rational method or formula approved by the Building Official.

3. **Static Load Tests.** When the allowable axial load of a single pile is determined by load test, one of the following methods shall be used:

Method 1. It shall not exceed 50 per cent of the yield point under test load. The yield point shall be defined as that point at which an increase in load produces a disproportionate increase in settlement.

Method 2. It shall not exceed one-half of the load which causes a net settlement, after deducting rebound, of one one-hundredth inch (.01") per ton of test load, which has been applied for a period of at least 24 hours.

Method 3. It shall not exceed one-half of that load under which, during a 40-hour period of continuous load application, no additional settlement takes place.

4. **Column Action.** All piles standing unbraced in air, water, or material not capable of lateral support, shall conform with the applicable column formula as specified in this Code. Such piles driven into firm ground may be considered fixed and laterally supported at five feet (5') below the ground surface and in soft material at ten feet (10') below the ground surface unless otherwise prescribed by the Building Official after a foundation investigation by an approved agency.

Piles: (Cont'd.)

5. **Piles in Subsiding Areas.** Where piles are driven through subsiding fills or other subsiding strata and derive support from underlying firmer materials, consideration shall be given to the downward frictional forces which may be imposed on the piles by the subsiding upper strata.

(c) **Protection of Pile Materials.** Where the boring records of site conditions indicate possible deleterious action on pile materials because of soil constituents, changing water levels or other factors, such materials shall be adequately protected by methods or processes approved by the Building Official. The effectiveness of such methods or processes for the particular purpose shall have been thoroughly established by satisfactory service records or other evidence which demonstrates the effectiveness of such protective measures.

(d) **Structural Strength of Piles and Limiting Values of Stresses.** The allowable compressive stresses on all piling materials shall not exceed the values as specified below except that stresses may be increased on submission of satisfactory data for specially protected, selected, or high strength, material.

1. Concrete—.225f'_c.
2. Structural steel—9000 pounds per square inch.
3. Wood—The allowable stress in compression parallel to the grain of round wood piles shall not exceed 60 per cent of the basic stress for clear material as recommended in U.B.C. Standard No. 25-2 and in no event shall the stress exceed 1000 pounds per square inch.
4. Reinforcing steel—as in Chapter 26.

The full load shall be assumed as carried on the pile cross-section located at the upper surface of the soil supporting the pile.

Where the influence of subsiding fills is considered as imposing loads in the pile, the above stresses may be increased if satisfactory substantiating data are submitted.

(e) **Round Wood Piles.** 1. **Quality.** Every wood pile shall conform to the specification for Class A or Class B piles in U.B.C. Standard No. 28-1.

2. **Treated Piles.** Creosoted piles of Douglas fir or of Southern pine shall be treated with Grade 1 creosote in accordance with U.B.C. Standard No. 28-2 with final retention of not less than 12 pounds per cubic foot for Douglas fir nor less than 15 pounds per cubic foot for Southern pine.

(f) **Pre-Cast Concrete Piles.** 1. **Quality.** Pre-cast concrete piles shall be cast in one piece and prior to driving and at 28 days after pouring shall develop an ultimate compressive strength (f'_c) of at least 3000 pounds per square inch.

2. **Reinforcement Ties.** The longitudinal reinforcement in driven pre-cast concrete piles shall be laterally tied with steel ties or wire spirals. Ties and spirals shall be spaced not more than three inches (3″) apart, center to center, for a distance of two feet (2′) from the ends and not more than eight inches (8″) elsewhere.

Piles: (Cont'd.)

3. **Diameter.** The diameter of ties and spirals shall be as follows: For piles having a diameter of sixteen inches (16") or less, wire shall not be smaller than No. 5 gauge.

For piles having a diameter of more than sixteen inches (16") and less than twenty inches (20"), wire shall not be smaller than No. 4 gauge.

For piles having a diameter twenty inches (20") and larger, wire shall not be smaller than one-quarter inch (¼") round or No. 3 gauge.

4. **Stresses.** Pre-cast concrete piling shall be designed to resist stresses induced by handling and driving as well as by loads.

(g) **Uncased Cast-In-Place Friction Piles. 1. Quality.** Concrete piles cast-in-place against earth in drilled or bored holes shall be made in such a manner as to insure the exclusion of any foreign matter and to secure a full-sized shaft. The length of such pile shall be limited to not more than 30 times the average diameter. Concrete shall have an ultimate compressive strength (f'_c) of not less than 2500 pounds per square inch.

2. **Friction.** Any uncased cast-in-place pile may be assumed to develop a frictional resistance equal to one-sixth of the bearing value of the soil material at minimum depth as stipulated in Table No. 28-A but not to exceed 500 pounds per square foot unless a greater value is prescribed by the Building Official after a soil investigation as specified in Section 2804.

3. **Combined Friction and Bearing Prohibited.** Frictional resistance and bearing resistance shall not be assumed to act simultaneously.

(h) **Metal-Cased Concrete Piles. 1. Dimensions.** Every metal casing for a concrete pile shall have a sealed tip with a diameter of not less than eight inches (8")

Concrete piles cast in place in metal shells shall have shells driven for their full length in contact with the surrounding soil and left permanently in place. The shells shall be sufficiently strong to resist collapse and sufficiently water tight to exclude water and foreign material during the placing of the concrete.

2. **Concrete.** All concrete used in metal-cased concrete piles shall have an ultimate compressive strength (f'_c) of not less than 2500 pounds per square inch.

3. **Order of Driving.** Piles shall be driven in such order and with such spacing as to insure against distortion of or injury to piles already in place. No pile shall be driven within four and one-half average pile diameters of a pile filled with concrete less than 24 hours old unless approved by the Building Official.

(i) **Concrete Filled Steel Pipe Piles. 1. Steel Pipe.** Steel pipe piles shall conform to U.B.C. Standard No. 28-3. If it is desired to use pipe of other material, satisfactory substantiating data must be submitted.

2. **Concrete.** The concrete used in concrete filled steel pipe

Piles: Allowable Loads (Cont'd.)

piles shall have an ultimate compressive strength (f'_c) of not less than 2500 pounds per square inch.

3. **Allowable Loads.** The allowable load on concrete-filled steel pipe piles shall not exceed 9000 pounds per square inch on the steel plus .225 of the ultimate compressive strength (f'_c) of the concrete.

(j) **Rolled Structural Steel Piles. 1. Material.** Structural steel piles shall conform to U.B.C. Standard No. 27-1.

No section shall have a nominal thickness of metal less than three-eighths inch (⅜").

(k) **Jetting.** Jetting shall not be used except where and as specifically permitted by the Building Official. When used, jetting shall be carried out in such a manner that the carrying capacity of existing piles and structures shall not be impaired. After withdrawal of the jet, piles shall be driven down until the required resistance is obtained.

(l) **Special Piles or Special Conditions.** The use of types of piles not specifically mentioned herein, and the use of piles under conditions not specifically covered herein, shall be permitted, subject to the approval of the Building Official, upon submission of acceptable test data, calculations or other information relating to the properties and load-carrying capacity of such piles.

CHAPTER 29 — VENEERED WALLS

General

Sec. 2901. (a) **Limitations.** Veneer shall not be assumed to add to the strength of any wall.

(b) **Height.** Exterior veneer shall not be attached to wood at any point more than twenty feet (20′) above the adjacent ground elevation.

(c) **Horizontal Forces.** Veneer shall not be assumed to resist horizontal forces, except as specifically provided in Section 2902.

(d) **Exceptions.** The limitations in this Chapter shall not apply to interior veneer of units five-eighths inch (⅝″) or less in thickness.

Veneer of Masonry Units

Sec. 2902. (a) **Scope.** The provisions of this Section shall apply to all veneer which is constructed of masonry conforming to the requirements of Chapter 24.

(b) **Vertical Loads.** No veneer shall support any vertical load other than the dead load of the veneer above. Veneer above openings shall be supported upon lintels of incombustible material.

(c) **Anchorage.** Masonry veneer shall be attached to the supporting wall with corrosion resistant metal ties, or other approved method, designed to resist a horizontal force equal to twice the weight of the attached veneer.

Veneer ties, if strand wire, shall be not less in thickness than No. 6 W. and M. gauge wire and shall have a hook embedded in the mortar joint, or if sheet metal, not less than 22 U.S. gauge corrugated. Each tie shall support not more than two square feet (2 sq. ft.) of wall area and shall be spaced not more than twenty-four inches (24″) on center horizontally.

In lieu of such wire ties, an approved method of grouting the veneer to a paper-backed reinforcement attached direct to the studs may be used.

(d) **Support.** The weight of masonry veneer shall be supported upon footings or other incombustible structural supports spaced not over twelve feet (12′) vertically above a point twenty feet (20′) above the adjacent ground elevation.

EXCEPTION: The weight of masonry veneer attached to wood frame walls shall be supported entirely upon footings.

Veneer of Non-Structural Units

Sec. 2903. (a) **Scope.** The provisions of this Section shall apply to all veneer of materials not regulated by the requirements of Chapter 24.

(b) **Loads and Stresses.** For the purpose of this Section, veneer of non-structural units shall not be assumed to support any superimposed loads.

(c) **Anchorage.** Non-structural material used as veneer shall be anchored to the supporting wall by corrosion-resistant metal ties not less in thickness than No. 9 W. & M.

Veneer of Nonstructural Units (Cont'd.)

gauge wire, and spaced not more than twelve inches (12″) apart both horizontally and vertically.

EXCEPTIONS: Approved units, or units of flat tile, stone or terra cotta which are manufactured with scored surface may be cemented to a masonry or concrete wall or to exterior plaster with Type A portland cement mortar, provided the mortar bond is sufficient to withstand a shearing stress of 50 pounds per square inch after curing for 28 days.

Special Requirements for Glass Veneer

Sec. 2904. (a) **General.** In addition to the general requirements of this Chapter, all veneer of glass shall comply with the regulations in this Section.

Glass veneer shall not be attached to any exterior wall at a point more than thirty-five feet (35′) above the adjoining ground elevation.

(b) **Dimension.** Glass veneer units shall be not less than one-eighth inch (⅛″) in thickness. Units less than three-sixteenths inch (3/16″) in thickness shall be not larger in area than one square foot (1 sq. ft.). Units not more than one-quarter inch (¼″) nor less than three-sixteenths inch (3/16″) in thickness shall be not larger in area than four square feet (4 sq. ft.).

No unit shall be larger in area than ten square feet (10 sq. ft.) or more than four feet (4′) in length.

(c) **Attachment.** Every glass veneer unit shall be attached to the backing by approved corrosion-resistant ties and shall be supported upon shelf angles.

EXCEPTIONS: 1. Below a point twenty-two feet (22′) above the adjacent ground elevations, the ties may be omitted.

2. Below a point three feet (3′) above the adjacent ground elevations, the ties and shelf angles may be omitted.

(d) **Mastic.** The mastic shall cover not less than one-half of the area of the unit after the unit has been set in place and shall be neither less than one-quarter inch (¼″) nor more than one-half inch (½″) in thickness.

The mastic shall be insoluble in water and shall not lose its adhesive qualities when dry.

Absorbent surfaces shall be sealed by a bonding coat before mastic is applied. The bonding coat shall be cohesive with the mastic.

Glass veneer surfaces, to which mastic is applied, shall be clean and uncoated.

(e) **Shelf Angles.** Shelf angles shall be of corrosion-resistant material capable of supporting four times the weight of the supported veneer.

The shelf angles shall be spaced vertically in alternate horizontal joints but not more than three feet (3′) apart.

The shelf angles shall be spaced not farther apart horizontally than the width of the supported units.

(f) **Backing.** Exterior glass veneer shall be applied only upon masonry, concrete, or exterior plaster.

(g) **Expansion Joints.** Glass veneer units shall be separated from each other and from adjoining materials by an expansion joint at least one thirty-second inch (1/32") in thickness. There shall be at least one-sixty-fourth inch (1/64") clearance between bolts and the adjacent glass.

Special Requirements for Glass Veneer (Cont'd.)

CHAPTER 30 — ENCLOSURE OF VERTICAL OPENINGS

Enclosures: When Required

Sec. 3001. Vertical openings are required to be enclosed as set forth in Table No. 17-A. For enclosures of stairways and ramps see Chapter 33.

Elevator Enclosures

Sec. 3002. Walls and partitions enclosing *elevators shall* be of not less than the fire-resistive construction required under Types of Construction in Part V. Enclosing walls of elevator shafts may consist of wire glass set in metal frames on the entrance side only. Elevator shafts extending through more than two stories shall be equipped with an approved means of adequate ventilation to and through the main roof of the building.

Other Vertical Openings

Sec. 3003. All shafts, ducts, chutes and other vertical openings not covered in Section 3002 shall have enclosing walls conforming to the requirements specified under Type of Construction of the building in which they are located.

Air Ducts

Sec. 3004. Air ducts passing through a floor shall be enclosed in a shaft. The shaft shall be as required for vertical openings in Part V. Dampers shall be installed where ducts pierce the shaft enclosure walls. Dampers shall conform to U.B.C. Standard No. 30-1. Air ducts in Group I Occupancies need not be enclosed in a shaft if conforming to Chapter 51. (See Appendix).

CHAPTER 31—FLOOR CONSTRUCTION

General

Sec. 3101. Floor construction shall be of materials and construction as specified under Occupancy in Part III and under Types of Construction in Part V.

All floors shall be so framed and tied into the framework and supporting walls as to form an integral part of the whole building.

The types of floor construction used shall provide means to keep the beams and girders from spreading by installing either ties or bridging with no laterally unsupported length of joists being permitted to exceed eight feet (8′) except as otherwise specified in Sections 3102 and 3103.

Fire-resistive standards of floor construction are specified in Section 4305.

Concrete Floors

Sec. 3102. Concrete slab floors shall be not less than two inches (2″) thick. Topping when poured monolithic with the slab may be included as a structural part of the slab. Sleepers for the nailing of a wood floor shall not decrease the required structural depth of the slab unless placed in the direction of span and then shall not be placed more than one-half inch (½″) into the slab.

Steel Joisted Floors

Sec. 3103. Steel joisted floors shall consist of steel joists as specified in Section 2715. When used in Type I or Type II buildings they shall have a reinforced concrete or gypsum slab not less than two inches (2″) thick placed on and secured to the top thereof, and a fire-resistive ceiling as specified in Section 4305, on the under side thereof, fully covering and protecting the joists; provided that when such joists are used in places where unprotected wood joists are permitted the steel joists need not be protected with fire-resistive materials as specified above.

The reinforced concrete or gypsum slab placed on and secured to the top of the steel joists shall be sufficiently reinforced to support all dead, live or other loads between joists. Joists shall be securely cross bridged at intervals not to exceed eight feet (8′) along the joist length.

Bridging shall be provided during the period of construction to support adequately the top chord or flange against lateral movement and such bridging shall be designed to hold each joist in a vertical plane. Sufficient permanent bridging shall be installed to stay the joists laterally and to transmit any horizontal forces in either direction perpendicular to the direction of the joists. Such bridging shall consist of solid concrete sections, structural steel shapes or plates, portal bridging, diagonal rods, or other bridging which will provide equal stiffness. Any row of bridging shall be capable of transferring 500 pounds from each joist to the adjoining joists.

Cellular Steel Floors

Sec. 3104. (a) **General.** Cellular steel floor construction shall consist of sheet or strip steel formed into an integrated system of parallel steel beams which combine the function of load-bearing members and a continuous deck spanning between main supporting girders, beams, or walls.

Cellular Steel Floors (Cont'd.)

When used in fire-resistive construction, steel floors shall have a minimum of two inches (2") of concrete fill on top and shall be protected with a fire-resistive ceiling suspended from the underside.

(b) **Physical Properties.** The steel used in the manufacture of steel floor units shall be equal to the requirements of U.B.C. Standard No. 27-2.

(c) **Minimum Thickness.** The thickness of the steel used in the manufacture of steel floors shall be not less than U. S. Standard Gauge No. 18.

(d) **Design.** Cellular steel floors shall admit of a rational analysis, and such floor assemblies shall have been tested and certified by a recognized testing agency to substantiate stress values used.

Flexural stress values shall not exceed 60 per cent of the yield point specified for the grade steel permitted in Subsection (b) of this Section.

When plastered ceilings are suspended from steel subfloor units, the maximum permissible deflection due to the full live load after the plaster is applied shall not exceed 1/360 of the span.

Wood Floors

Sec. 3105. (a) **Wood Joisted Floors.** Wood joisted floors shall be framed and constructed and anchored to supporting wood stud or masonry walls as specified in Chapter 25. Wood joisted floors need not be fire-protected on the under side except where specifically required under Occupancy in Part III, Location in Part IV, or Type of Construction in Part V.

Girders supporting first floor joists in residence buildings shall be not less than four inches by four inches (4"x4") for spans of five feet (5') or less, or not less than four inches by six inches (4"x6") (placed on edge) for spans not more than seven feet (7').

Where the joists are not designed as specified in Chapter 25, Table No. 31-A gives the maximum allowable spans for floor joists of a grade not less than 1100*f* or No. 2 Douglas fir or Southern pine or comparable grades in other species surfaced four sides to U.B.C. Standard No. 25-1 sizes and based on live load of 40 pounds per square foot uniformly distributed.

Joists of other grades, other woods and other sizes may be used, in which case they shall not be stressed to exceed the maximum allowable fiber stress as specified in Chapter 25.

Floor joists shall have a clearance of not less than eighteen inches (18") between the bottom of the joists and the surface of the ground underneath.

In wood frame floor construction where suspended ceilings occur, the space between the ceiling and the floor above shall be divided into areas not exceeding one thousand square feet (1000 sq. ft.) in a manner required for partitioning attic space in Section 3205.

(b) **Plywood Flooring.** Where used as flooring, plywood shall be of the minimum thicknesses specified in Table No. 31-B.

TABLE NO. 31-A—ALLOWABLE SPANS FOR FLOOR JOISTS

Wood Floors (Cont'd.)

SIZE (Inches)	SPACING CENTER TO CENTER (Inches)	MAXIMUM ALLOWABLE SPAN (Feet and Inches)	
		Plastered Ceiling Below	Without Plastered Ceiling Below
2 x 6	12	10-5	11-6
	16	9-1	10-0
	24	7-8	8-2
2 x 8	12	13-10	15-2
	16	12-1	13-3
	24	9-11	10-11
2 x 10	12	17-5	19-1
	16	15-2	16-8
	24	12-6	13-9
2 x 12	12	20-11	22-11
	16	18-3	20-1
	24	15-1	16-7
2 x 14	12	24-4	26-7
	16	21-4	23-5
	24	17-8	19-5
3 x 6	12	12-4	14-5
	16	11-3	12-7
	24	9-10	10-4
3 x 8	12	16-4	18-11
	16	14-11	16-7
	24	13-1	13-9
3 x 10	12	20-6	23-7
	16	18-10	20-10
	24	16-5	17-3
3 x 12	12	24-6	28-2
	16	22-7	24-11
	24	20-0	20-9
3 x 14	12	28-7	30-6
	16	26-4	28-3
	24	23-1	24-2

Mill Constructed Floors

Sec. 3106. Mill constructed floors shall be not less than three inches (3") nominal splined or tongued and grooved plank covered with one inch (1") nominal flooring laid crosswise or diagonal. Top flooring shall not extend closer than one-half inch (½") to walls to allow for swelling in case the floor becomes wet. Such one-half inch space shall be covered by a molding fastened to the wall and so arranged that it will not obstruct the swelling or shrinking movements of the floor. Corbeling of masonry walls under floor planks may be used in place of such molding.

TABLE NO. 31-B—MINIMUM THICKNESSES OF PLYWOOD

PLYWOOD THICKNESS (Inches)	LIVE LOADS (lbs. per sq. ft.)	
	20	40
1/4	18 inch span	12 inch span
3/8	22 inch span	16 inch span
1/2	27 inch span	21 inch span
5/8	33 inch span	24 inch span

If laminated floors are used, at least two laminations at the wall shall be omitted until after glazing and roofing has been completed.

See Section 2517 (b) for detailed requirements.

CHAPTER 32—ROOF CONSTRUCTION AND COVERING

General

Sec. 3201. Roof covering shall be as required under Occupancy in Part III, Location in Part IV or Types of Construction in Part V. All roofs shall be so framed and tied into framework and supporting walls as to form an integral part of the whole building.

Construction

Sec. 3202. The general requirements for construction of floors as specified in Chapter 31 shall apply to roofs except that in Type III buildings the roof sheathing shall be not less than two inches (2") nominal in thickness and except that concrete or gypsum roof slabs shall be not less than two inches (2") in thickness.

Roof trusses shall have all joints well fitted and shall have all tension members well tightened before any load is placed on the truss. Diagonal and sway bracing shall be used to brace all roof trusses. The allowable working stresses of materials in trusses shall be as specified in Chapters 25 and 27. The minimum net section of the members after framing shall be used in determining the strength of the truss at any point.

Plywood roof sheathing, unless of exterior type, shall have no surface or edge exposed to weather.

TABLE NO. 32-A—ALLOWABLE SPANS FOR CEILING JOISTS AND ROOF RAFTERS

SIZE (Inches)	SPACING CENTER TO CENTER (Inches)	MAXIMUM ALLOWABLE SPAN (Feet and Inches)			
		Ceiling Joists	Rafters		
			Slope of Less than 4 in 12	Slope of 4 in 12 to 12 in 12	Slope of 12 in 12 and Greater
2 x 4	12	11-0	9-11	11-0	11-10
	16	10-1	8-8	9-7	10-5
	24	8-11	7-1	7-11	8-7
	32	8-1	6-1	6-10	7-5
2 x 6	12	16-7	15-1	16-9	18-3
	16	15-4	13-3	14-8	16-0
	24	13-8	10-11	12-2	13-2
	32	12-2	9-5	10-8	11-7
2 x 8	12	21-7	19-10	21-10	23-9
	16	20-1	17-5	19-3	22-0
	24	17-11	14-6	16-0	17-4
	32	16-6	12-6	14-0	15-2
2 x 10	12	26-9	24-9	27-2	29-8
	16	25-0	21-10	24-0	26-2
	24	22-5	18-2	20-1	22-0
	32	20-8	15-9	17-6	19-2

Design

Sec. 3203. The design of the roof construction shall be in accordance with engineering regulations for the materials used.

Where the roof is not designed as specified in Chapter 25, Table No. 32-A gives the maximum allowable spans for ceiling joists and roof rafters of a grade not less than 1100/ or No. 2 Douglas fir or Southern pine or comparable grades in other species, surfaced four sides to U.B.C. Standard No. 25-1 sizes and based on the live loads specified in Section 2305.

Joists or rafters of other grades, other woods and other sizes may be used, in which case they shall not be stressed to exceed the minimum allowable fiber stress as specified in Chapter 25.

The allowable span of roof rafters shall be measured from plate to ridge, except that where rafters are braced to ceiling joists and a complete truss is formed, the spans shall be considered as the distance between intersecting points of trussing.

Roof framing and trussing shall be thoroughly and effectively angle braced. Roof joists when supported on a ribbon board shall be well nailed to the stud.

Roof Coverings

Sec. 3204. (a) **General.** Roof coverings for all buildings shall be either "Fire-Retardant" or "Ordinary" roof coverings as specifically required either by Location in Part IV or by Type of Construction in Part V. The roof covering shall be securely fastened to the supporting roof construction.

(b) Composition Roofing Materials. For purposes of this Section, certain terms are designated as follows:

Felt—Roofing felt made from organic or asbestos fibers saturated with bituminous compound.

Cap Sheet—Roofing made of organic or asbestos fibers saturated and coated on both sides with a bituminous compound and surfaced with mineral granules, mica, talc, ilmenite, asbestos fibers or similar materials, except on the unexposed portions of split cap sheets.

Cementing Materials—Built-up composition roof shall be thoroughly mopped solid between layers with bituminous compound using not less than 20 pounds of hot asphalt or not less than one and one-half gallons of cold bituminous compound in accordance with roofing manufacturer's published specifications or hot coal tar pitch, using 30 pounds per one hundred square feet (100 sq. ft.) of roof area.

Spot Cementing—Intermittent application of asphalt sealing agent in an amount not less than 10 pounds per one hundred square feet (100 sq. ft.) of roof area at points not more than twelve inches (12") apart.

Base Sheets—One or more layers of saturated felt or saturated and coated roofing products over which is placed a cap sheet, asbestos shingles, composition shingles, gravel surfacing, ceramic or other similar surfacing materials.

(c) **Materials.** All materials shall be delivered in original packages bearing manufacturer's label. Mineral surfaced cap

sheets, asphalt shingles and smooth surface cap sheets shall bear the label of the Underwriters' Laboratories, Inc., for Class A, B or C roofing. **Roof Coverings (Cont'd.)**

Nails for composition roof shall not be smaller than 12 gauge, with heads not less than three-eighths inch (⅜") in diameter for shingle application and nine-sixteenths inch (9/16") for built-up roofs and shall be long enough fully to penetrate the sheathing with a maximum three-fourths inch (¾"). Smaller head nails may be substituted providing metal discs are used with them. Exposed nails and shingle nails shall be corrosion resistant.

(d) **Application.** Base sheets shall be nailed to the roof sheathing using not less than one nail to each one and one-third square feet (1⅓ sq. ft.) of roof area, or base sheets may be spot cemented to an existing composition roof, or spot cemented or fully mopped to a suitable deck.

Asphalt shingles shall be nailed according to manufacturer's printed specifications, but for strip shingles of square tab type, weighing approximately 210 pounds per square and measuring twelve inches by thirty-six inches (12"x36"), no less than six nails shall be used per each strip.

Hot asphalt shall be applied at a temperature of not less than 375 degrees Fahrenheit and shall in no case be heated to a temperature higher than 425 degrees Fahrenheit at the kettle.

Coal tar pitch shall not be heated above 375 degrees Fahrenheit.

(e) **Fire-Retardant Roof Coverings.** A fire-retardant roof covering shall be any roof covering which meets the requirements specified for any one of the following roofings, 1 to 7 inclusive, or shall be any roof assembly bearing the label of the Underwriters' Laboratories, Inc., for Class A or B roofing.

1. Any built-up composition roofing consisting of materials whose fire-retardant values as set forth in Table No 32-B equal not less than 15 points including a top covering selected from parts (b), (c) or (d) of said table.

2. Hydraulic compressed rigid shingles not less than one-eighth inch (⅛") thick, composed of portland cement and asbestos fibers, laid over a layer of saturated felt weighing not less than 14 pounds to the one hundred square feet (100 sq. ft) or hydraulic compressed rigid sheets not less than seven thirty-seconds inch (7/32") thick, composed of portland cement and asbestos fibers. The aforesaid felt may be omitted when the compressed shingles are placed over an existing roof covering.

3. Asphalt-saturated mineral-surfaced prepared composition shingles laid so there are not less than two thicknesses at any point. The combined weight of such shingles shall be not less than 200 pounds to the one hundred square feet (100 sq. ft.) of completed roof area.

4. Concrete slab or concrete tile roofs, constructed as specified in Chapter 26 without additional roof covering.

5. Metal roof covering of corrugated, standing seam or flat

TABLE NO. 32-B—FIRE-RETARDANT VALUES OF ROOFING MATERIALS

		SHIPPING WEIGHT (In lbs.)	TYPES OF MATERIALS	MIN. WT. PER 100 SQ. FT. OF ROOF AREA (In lbs.)	FIRE-RETARDANT VALUE
(a)	BASE SHEETS ONLY	15	Asphalt Saturated Felt	14	3
		30	Asphalt Saturated Felt	28	6
		20	Asphalt Saturated and Coated Dampcourse	18	4
		40	Asphalt Smooth Surfaced Roofing	37	6
		15	Asphalt Saturated Asbestos Felt	14	5
		20	Asphalt Saturated Asbestos Felt	18	5
(b)	BASE OR CAP SHEETS	45	Asphalt Saturated Asbestos Felt (Black Top)	41	9
		55	Asphalt Saturated Asbestos Felt (Black Top)	50	10
		15	Asphalt Saturated Asbestos Felt (minimum 2 layers)	28	10
(c)	CAP SHEETS ONLY	55	Mineral Surfaced Split Sheets (minimum 2 layers)	106	12
		58	Ilmenite Surfaced Split Sheets (minimum 2 layers)	106	12
		58	Ilmenite Surfaced Roofing	55	7
		90	Mineral Surfaced Asphalt Cap Sheet	83	10
		75	Smooth Surfaced Cap Sheet	68	9
		65	Smooth Surfaced Cap Sheet	60	7
		55	Smooth Surfaced Cap Sheet	50	6
		39	Asphalt Saturated Asbestos Roofing (White Top)	37	9
		55	Asphalt Saturated Asbestos Roofing (White Top)	52	10
(d)	GRAVEL, CERAMIC AND OTHER SIMILAR SURFACING MATERIALS		Gravel ¼" to ½" in size	400	6
			Slag ¼" to ½" in size	300	6
			Ceramics and other surfacing materials ⅛" to ½" in size	300 400	4 6

Roof Coverings (Cont'd.)

type of not less than No. 30 U. S. gauge metal. All flat metal roof coverings shall be laid on solid sheathing. Corrugated or standing seam metal roof covering shall be designed to support the required live load between supporting members.

6. Slate shingles securely fastened with copper nails or with copper nails and No. 14 B. and S. gauge copper wire, with nails of such length as to provide not less than three-fourths inch (¾") of penetration into the nailing strips or sheathing. Under all such shingles there shall be placed at least one layer of asphalt saturated felt weighing not less than 30 pounds to 108 square feet.

7. Clay roof tile securely fastened with copper nails or copper wire; provided that for roofs not exceeding a rise of eight inches (8") in twelve inches (12"), galvanized iron nails may be used, and provided further that tile with projection lugs need not be nailed or wired in place. Wire shall be not smaller than No. 14 B. and S. gauge. Nails shall penetrate the supporting roof construction not less than three-fourths inch (¾").

Roofing tile other than flat pan tile with or without flanges, or flat shingle tile, or flat decorative tile, shall satisfy the following strength requirements: When supported on the turned-down edges at points six inches (6") each side of the center of the tile, giving four points of support and a span of twelve inches (12") and loaded with a concentration at the center, the average breaking load per tile for five representative tile tested shall be not less than 400 pounds and the breaking load for any individual tile tested shall be not less than 350 pounds.

Roof tile shall not absorb more than 15 per cent of the dry weight of the tile during a 48-hour immersion test.

Under all burned clay units, there shall be placed not less than two layers of asphalt saturated rag felt, each layer weighing not less than 14 pounds to one hundred square feet (100 sq. ft), solidly mopped between and surfaced with asphalt.

(f) **Ordinary Roofings.** "Ordinary" roofing shall be any roof covering which meets the requirements specified for any one of the following roofings, 8 to 10 inclusive, or shall be any roofing meeting the Class C Specifications of the Underwriters' Laboratories, Inc.

8. Any composition roofing or any built up composition roofing consisting of layers of roofing felt, roll roofing, felt membrane or gravel, the sum of whose fire-retardant values as set forth in Table No. 32-B equals not less than 10.

9. Asphalt shingles laid in one or more layers.

10. Wood shingles of clear vertical grain all-heart wood, not less in thickness than five shingles to two inches (2") at the butt, laid with the following exposures:

Total Length of Shingle	Permissible Exposed Length
16 in.	5 in.
18 in.	5½ in.
24 in.	7½ in.
32 in.	9½ in.
36 in.	11 in.

All wood shingles shall be nailed firmly with copper, zinc, zinc-coated or commercially pure iron nails of at least 14

Roof Coverings (Cont'd.)

B. and S. gauge and not less than one and one-fourth inch (1¼") long. Each shingle shall be nailed with two nails driven substantially into the supporting roof construction.

Wood shingles bearing the label of any recognized inspection agency, certifying compliance with U.B.C. Standard No. 32-1, may be accepted as meeting the requirements of this Code.

(g) **Roofings for Group J Occupancies.** On buildings housing Group J Division 1 occupancies any composition roofing having a fire-retardant value equal to not less than six, as set forth in Table No. 32-B, may be used, unless otherwise required because of location as specified in Parts IV and V of this Code.

Roof Insulation

Sec. 3205. The use of cork, fiberboard and other combustible roof insulation shall be permitted in all types of construction provided it is covered with approved roof coverings applied directly thereto.

Attics: Access and Areas

Sec. 3206. All buildings shall have access provided to the attic space by means of a stairway or permanent ladder or a scuttle. The openings provided through the ceiling for such access into the attic space shall be not less than twenty-two inches by thirty inches (22"x30") and shall be located in the hallway or corridor of all Type III and V buildings three stories or more in height.

Type III or V buildings, one or two stories in height, shall have scuttle holes into the attic space which are not less than eighteen inches (18") square.

In wood frame roof construction where ceilings occur the attic spaces or spaces between ceilings and the under side of roofs shall be divided into horizontal areas of not more than twenty-five hundred square feet (2500 sq. ft.) with tight one-inch (1") partitions of matched wood, one-half inch (½") thick exterior type plywood, or approved incombustible materials. All openings through these partitions shall be protected by self-closing doors of the same thickness and materials as the partition.

EXCEPTION: Where the attic is fully sprinklered the divided horizontal area may be tripled.

In buildings with no ceilings and having rooms with floor areas of over thirty thousand square feet (30,000 sq. ft.), tight draft stops shall be installed to prevent a free current of air under the roof. These draft stops in trussed roofs shall extend from the roof down to the bottom chord of the truss and shall divide the under roof or attic into sections not to exceed twenty thousand square feet (20,000 sq. ft.) in area.

Roof Drainage

Sec. 3207. The water from the roof of all buildings which would flow by gravity over a public sidewalk shall be carried by means of conductors under the sidewalk and through the curb into the gutter. Overflows shall be installed at each low point of the roof to which the water drains.

EXCEPTION: Buildings of Group I, or J, the walls of which are ten feet (10') or more from the street property line, need not comply with the above.

CHAPTER 33—STAIRS, EXITS AND OCCUPANT LOADS

General

Sec. 3301. (a) **Purpose.** The purpose of this Chapter is to determine occupant loads and to provide minimum standards of egress facilities for occupants of buildings.

(b) **Scope.** Every building shall be provided with exits as required by this Chapter. Where there is conflict between a general requirement and a specific requirement for an individual occupancy, the specific requirement shall be applicable.

(c) **Definitions.** "Occupant Load" is the total number of persons actually occupying a building or portion thereof at any one time, but shall never be assumed to be less than the result obtained by dividing the floor area by the square feet per occupant set forth in Table No. 33-A for the occupancy housed therein. When the square feet per occupant is not given for a particular occupancy it shall be determined by the building official, based on the square feet given for the occupancy which it most nearly resembles.

"Panic hardware" is a bar which extends across at least half the width of each door leaf, or is a floor plate below the full width of each door opening; either of which will open the door if subjected to pressure.

(d) **Room Capacity.** The occupant load of a room or building shall be the actual number of seats but not less than the result obtained by dividing the floor area by the square feet per occupant set forth in Table No. 33-A.

(e) **Benches.** Where benches or pews are used the number of seats shall be based on one person for each eighteen inches (18") of length of the pews or benches.

(f) **Mixed Occupancies.** The capacity of a building containing mixed occupancies shall be determined by adding the number of occupants of the various portions as set forth in Table No. 33-A.

TABLE NO. 33-A—AVAILABLE SQUARE FEET PER OCCUPANT

OCCUPANCY	SQUARE FEET PER OCCUPANT
Assembly Areas	7
Classrooms	20
Dance Floors	7
Dining Rooms	15
Dwellings (Group I)	300
Gymnasiums	15
Homes for Children and Aged	50
Hospitals and Sanitariums	100
Sales—Retail	
Basement	20
First Floor	30
Upper Floors	50
School Shops and Vocational Rooms	50
Skating Rinks	15
All Others	100

General (Cont'd.)

(g) **More Than One Occupancy.** The capacity of a room or building which is used for different occupancies at different times shall be determined by the occupant load which gives the largest number of persons.

(h) **Exit Obstruction.** No obstruction shall be placed in the required width of an exit.

(i) **Room Capacity Posted.** The maximum room capacity shall be conspicuously posted by the owner of the building by means of durable metal signs placed in each assembly room, auditorium or room used for a similar purpose where fixed seats are not installed, and it shall be unlawful to remove or deface such notice or to permit more than this legal number of persons within such space.

(j) **Change in Elevation.** Changes in elevation of less than twelve inches (12"), along any means of egress within a building, shall be by means of ramps, except for occupant loads less than ten (10).

Exits Required

Sec. 3302. (a) **Number of Persons.** The number of persons permitted in any building or portion thereof shall not exceed those set forth in Table No. 33-A, except that where additional exit facilities are provided the occupancy load may be increased in accordance with Section 3302 (b) and (c).

(b) **Number of Exits.** Group D and Group H occupancies having an occupant load of more than 10 shall have not less than two exits.

Other occupancies having an occupant load of more than 50 shall have not less than two exits.

Buildings or portions thereof having an occupant load of 500 to 999 shall have not less than three exits.

Buildings or portions thereof having an occupant load of 1000 or more shall have not less than four exits.

(c) **Width.** The total width of exits in feet shall be not less than the total occupant load served divided by 50. Such width of exits shall be divided approximately equally among separate exits.

The width of exits from any story of a building shall be determined from the occupant load in that story plus one-half the tributary occupant load in the story next above or below, provided the resulting width is not less than that required for the upper story considered separately. The maximum exit width required for any story shall be maintained until egress is provided from the structure.

(d) **Arrangement of Exits.** If only two exits are required they shall be placed a distance apart equal to not less than one-fifth of the perimeter of the room. Where three or more exits are required they shall be arranged a reasonable distance apart so that if one becomes blocked others will be available.

No point in an unsprinklered building shall be more than one hundred fifty feet (150') from an exterior exit, a horizontal exit, or an enclosed stairway, measured along the line of travel.

In a building of Type I or Type II construction or where the building is completely sprinklered, the above distance from exits may be increased to two hundred feet (200').

Doors

Sec. 3303. (a) **General.** This Section shall apply to every exit door serving an occupant load of more than 10, and from hazardous rooms or areas.

(b) **Swing.** Exit doors shall swing in the direction of exit travel when serving an occupant load of 50 or more.

(c) **Operation.** Exit doors shall be openable from the inside without the use of key or any special knowledge or effort.

(d) **Width.** The required width of a door opening shall not be reduced more than three inches (3″) by any projections.

No required doorway shall be less than thirty-six inches (36″) in width.

(e) **Door Leaf Width.** No leaf of an exit door shall exceed four feet (4′) in width.

(f) **Special Doors.** Revolving, vertical sliding, and overhead rolling doors shall not be used unless exit doors of required width are installed adjacent thereto.

(g) **Egress from Door.** Every door shall open into a corridor, enclosed stairway, exterior stairway where permitted as a required exit, and exterior exit court, or public way.

(h) **Doors Opening into Stairway.** Every door opening into a stairway shall open on a landing within two inches (2″) of the floor level. The width of the landing shall not be reduced more than six inches (6″) by the door when fully open.

Corridors

Sec. 3304. (a) **General.** This Section shall apply to every corridor serving as a required exit for an occupant load of more than 10.

(b) **Width.** Every required corridor shall be not less in width than forty-four inches (44″).

(c) **Projections.** The required width of corridors shall be unobstructed.

EXCEPTIONS: 1. Trim and handrails may project three and one-half inches (3½″).

2. Doors, when fully open, may project six inches (6″).

(d) **Access to Exits.** Floors above the first floor shall have exits so arranged that it is possible to go in either direction from any point in a corridor to a stairway.

(e) **Walls.** Corridor walls and ceilings shall be of not less than one-hour fire-resistive construction, except one-story buildings housing Groups F and G occupancies.

(f) **Corridor Dead End.** There shall be no dead end in any corridor or hall more than twelve feet (12′) beyond the exit stair or door.

(g) **Openings.** Where corridor walls are required to be one-hour fire-resistive, doors shall be class "E" or "F" or steel or a one and three-eighths inch (1⅜″) solid core wood door and other interior openings shall be of one-fourth inch (¼″) wire glass set in steel frames. Openings, other than doors, shall not exceed 25 per cent of the area of the corridor walls.

Stairs

Sec. 3305 (a) **Width.** Stairways serving an occupant load of more than 50 shall be not less in width than forty-four inches (44″).

Stairways serving an occupant load of 50 or less may be thirty-six inches (36″) wide.

Stairways serving an occupant load of 10 or less may be thirty inches (30″) wide.

Trim and handrails may project three and one-half inches (3½″) into the required width of any stairway.

(b) **Rise and Run.** The rise of every step in a stairway shall not exceed seven and one-half inches (7½″), and the run shall be not less than ten inches (10″).

Except as provided under Subsection (c) of this Section, the maximum variations in the height of risers and in the width of treads in any one flight shall be three-sixteenths inch (3/16″).

EXCEPTION: In stairways serving an occupant load of 50 or less or serving temporary reviewing stands, the rise may be eight inches (8″) and the run may be nine inches (9″).

(c) **Winders.** In Group I occupancies and in monumental unrequired stairways, winders may be used if the required width of run is provided at a point not more than twelve inches (12″) from the side of the stairway where the treads are the narrower, but in no case shall any width of run be less than six inches (6″) at any point.

(d) **Landings.** Every intermediate landing shall have a dimension measured in the direction of travel equal to the width of the stairway, but such dimension need not exceed four feet (4′).

In Groups A, B, and C occupancies the walls at the outer corners of landings shall be curved on a radius of at least two feet (2′), or a 45-degree splay not less than twenty inches (20″) wide shall be provided to eliminate right-angle corners.

(e) **Basement Stairways.** Where a basement stairway and a stairway to an upper story terminate in the same vestibule or other space, the basement stairway shall be cut off by a one-hour fire-resistive partition and a self-closing Class "B" fire door.

(f) **Distance Between Landings.** There shall be not more than twelve feet (12′) vertically between landings.

(g) **Handrails.** Stairways shall have handrails on each side, and every stairway more than eighty-eight inches (88″) in width shall have intermediate handrails dividing the stairway into portions not more than sixty-six inches (66″) in width.

Handrails shall be placed not less than thirty inches (30″) nor more than thirty-four inches (34″) above the nosing of treads, and ends of handrails shall be returned to the wall.

EXCEPTIONS: 1. Stairways three feet (3′) or less in width may have one handrail.

2. Handrails shall not be required for exterior monumental stairways.

(h) **Exterior Stairways.** Every opening in the exterior wall of a building served by an exterior stairway used as a required exit shall be protected by an automatically closing

Class "E" or "F" fire door or window if the opening is within twenty feet (20′) of the stairway. **Stairs (Cont'd.)**

EXCEPTION: Openings above or level with the highest portion of the stairway may be unprotected if not nearer than ten feet (10′) to the stairway.

(i) **Stairway Construction—Interior.** Interior stairways shall be constructed as specified in Part V of this Code. Stairs serving as egress from corridors which are required to be one-hour fire-resistive construction in Section 3304 (e), shall have walls and soffits of one-hour fire-resistive construction. Where there is enclosed usable space under stairways of wood or unprotected metal, the soffits of the stairs shall be protected as required for one-hour fire-resistive construction.

(j) **Stairway Construction—Exterior.** Exterior stairs shall be of incombustible material except that on buildings not exceeding two stories in height they may be of wood not less than two inches (2″) in nominal thickness.

(k) **Stairway to Roof.** In every building more than two stories in height, one stairway shall extend to the roof surface unless the roof has a slope greater than four in twelve.

(l) **Headroom.** Every required stairway shall have headroom clearance of not less than six feet six inches (6′6″) measured vertically from the nearest nosing to the nearest soffit.

Sec. 3306. (a) **General.** A ramp conforming to the requirements of this Section may be used as an exit. **Ramps**

(b) **Width.** The width of ramps shall be as required for corridors.

(c) **Slope.** The slope of a ramp shall not exceed one in eight.

(d) **Handrails.** A ramp with slope exceeding one in ten shall have handrails as required for stairways.

(e) **Construction.** Ramps shall be constructed as required for stairways.

(f) **Surface.** The surface of ramps shall be roughened or shall be of non-slip material.

Sec. 3307. (a) **Definition.** A horizontal exit is a horizontal passageway or ramp into another building or into another section of the same building through a "One-Hour Fire-Resistive Occupancy Separation." **Horizontal Exits**

(b) **Used as a Required Exit.** If conforming to the provisions of this Chapter, a horizontal exit may be considered as a required exit.

(c) **Discharge Areas.** A horizontal exit shall lead into a floor area having capacity for an occupant load not less than the occupant load served by such exit. The capacity shall be determined by allowing three square feet (3 sq. ft.) of net clear floor area per occupant. The area into which the horizontal exit leads shall be provided with exits as required by Section 3302, at least one of which shall lead directly to a public way.

Exit Enclosures

Sec. 3308. (a) **General.** Every interior stairway, ramp, or escalator shall be enclosed as specified in this Section.

EXCEPTIONS: 1. In occupancies other than Group D, an enclosure will not be required for a stairway, ramp, or escalator serving only the second floor and not connected with corridors or stairways serving floors above the second floor.

2. In sprinklered buildings of Type I construction housing Group F and G occupancies, enclosures are not required for escalators.

3. Stairs in Group I occupancies need not be enclosed.

(b) **Enclosure Construction.** Enclosure walls shall be of not less than two-hour fire-resistive construction in buildings more than four stories in height and shall be of not less than one-hour fire-resistive construction elsewhere.

(c) **Openings into Enclosures.** There shall be no openings into exit enclosures except exit doorways and openings in exterior walls. Every exit door in an exit enclosure shall be a self-closing Class "B" fire door. Every opening in an exterior wall forming part of an exit enclosure shall be protected by a Class "E" or "F" fire door or window unless opening into a public way at least sixteen feet (16') wide.

(d) **Extent of Enclosure.** Stairway and ramp enclosures shall include landings and parts of floors connecting stairway flights and shall also include a corridor on the ground floor leading from the stairway to the exterior of the building. Enclosed corridors or passageways are not required from unenclosed stairways.

Smokeproof Enclosures

Sec. 3309. (a) **General.** A smokeproof enclosure shall consist of a continuous stairway enclosed from the highest point to the lowest point by walls of two-hour fire-resistive construction. The supporting structural frame shall be of four-hour fire-resistive construction.

(b) **Where Required.** In buildings five stories or more in height, one of the required exits shall be a smokeproof enclosure.

(c) **Construction.** Stairs in smokeproof enclosures shall be of incombustible construction.

(d) **Access.** There shall be no opening directly into the interior of the building. Access shall be through a vestibule open to the outside having an exit door from the interior of the building and an exit door leading to the smokeproof enclosure. In lieu of a vestibule, access may be by way of an exterior open balcony of incombustible materials.

(e) **Doors.** Exit doors to smokeproof enclosures shall be self-closing Class "B" fire doors.

(f) **Outlet.** A smokeproof enclosure shall exit into a public way or into a passageway leading to a public way. The passageway shall be without other openings and shall have walls of two-hour fire resistance and floors and ceilings of two-hour fire resistance.

(g) **Barrier.** A smokeproof enclosure stair shall not continue below the grade level exit unless a barrier is provided at the ground floor level to prevent persons from continuing on into the basement.

Exit Outlets

Sec. 3310. Every exit shall discharge into a public way or exit court.

Exit Courts

Sec. 3311. (a) **Discharge.** Every exit court shall discharge into a public way or passageway leading to a public way. The passageway shall be without other openings and shall have walls, floors, and ceilings of the same period of fire resistance as the walls, ceilings, and floors of the building but shall be not less than one-hour construction.

(b) **Width.** Every exit court shall be not less in width than the required total width of the tributary exits.

(c) **Slope.** The slope of exit courts shall not exceed one in ten.

(d) **Openings.** Openings between a Group A and B occupancy and an exit court less than sixteen feet (16') wide shall be protected by Class "E" or "F" fire doors or windows.

EXCEPTION: Openings more than twenty feet (20') above the floor of the exit court may be unprotected.

(e) **Obstructions.** The required width of exit courts shall be unobstructed except for trim and handrails which may project not more than three and one-half inches (3½") into the required width.

At any point where the width of an exit court is reduced from any cause, the reduction in width shall be effected gradually by a guard rail at least three feet (3') high. The guard rail shall make an angle of not more than 30 degrees with the axis of the exit court.

Exit Signs and Illumination

Sec. 3312. (a) **Exit Illumination.** Exits shall be illuminated at all times with light having an intensity of not less than one foot candle at floor level.

(b) **Exit Signs.** At every exit doorway, and wherever otherwise required to clearly indicate the direction of egress an exit sign with letters at least five inches (5") high shall be provided from all areas serving the occupant load specified in this Subsection. In interior stairways the floor level leading direct to the exterior shall be clearly indicated.

1. Groups B, C, D and H with an occupant load of more than 50.

2. All other occupancies serving an occupant load of more than 100.

(c) **Illumination of Signs.** Exit signs shall be lighted in the following occupancies with two electric lamps of not less than 15 watts each in the manner specified in this Subsection.

1. Two separate sources of supply shall be required for Group A occupancies and Divisions 1 and 2 of Group B except buildings with occupant loads less than 750 persons used as churches, lodge rooms, recreation halls and gymnasiums.

2. Separate circuits, one of which shall be separate from all other circuits in the building, shall be required for the following occupancies:

(1) Groups A, B, and C occupancies with an occupant load over 300 persons and not otherwise regulated in this sub-section.

(2) Group D and H occupancies with an occupant load over 100 persons.
(3) Group F occupancies with an occupant load over 1000 persons.

Aisles

Sec. 3313. (a) General. Every portion of every building in which are installed seats, tables, or equipment, shall be provided with aisles leading to an exit.

(b) **Width.** Every aisle shall be not less than three feet (3′) wide if having seats on only one side and not less than three feet six inches (3′ 6″) wide if having seats on both sides. Such minimum width shall be measured at the end farthest from the foyer and shall be increased by one and one-half inches (1½″) for each five feet (5′) in length toward the foyer.

EXCEPTION: In Group B, Division 4 occupancies, aisles need not be over three feet six inches (3′ 6″) wide.

(c) **Distances to Nearest Exit.** In areas occupied by seats, and in Group A and B occupancies without seats, the line of travel to an exit door by an aisle shall not be more than one hundred and fifty feet (150′).

(d) **Aisle Spacing.** Aisles shall be located so that there will be not more than six intervening seats between any seat and the nearest aisle.

EXCEPTION: There may be 20 intervening seats between any seat and the nearest aisle in Group B, Division 4 occupancies.

(e) **Cross Aisles.** When aisles terminate in a cross aisle instead of a foyer, the width of the cross aisle shall be not less than the sum of the width of the widest aisle plus 50 per cent of the total width of the remaining aisles leading thereto.

(f) **Vomitories.** Vomitories connecting the main exit with the cross aisles shall have a total width not less than the sum of the width of the widest aisle leading thereto plus 50 per cent of the total width of the remaining aisles leading thereto.

(g) **Slope.** The slope of aisles shall not exceed one foot (1′) fall in eight feet (8′).

Seats

Sec. 3314. (a) Spacing. The spacing of rows of seats from back to back shall be not less than thirty-three inches (33″), nor less than twenty-seven inches (27″) plus the sum of the thickness of the back and inclination of the back.

EXCEPTION: In Group B, Division 4 occupancies, the spacing of rows of seats without backs may be twenty-two inches (22″).

(b) Width. The width of any seat shall be not less than eighteen inches (18″).

Bleacher Seats

Sec. 3315. Rollaway, telescoping, and fold-up bleacher seats without backs shall conform to the requirements of this Section.

Bleacher sections shall contain not more than 20 rows of seats.

Bleacher Seats (Cont'd.)

Spacing of seats back to back shall be not less than twenty-two inches (22").

Bleacher sections shall be provided with aisles.

EXCEPTION: Bleachers with not more than 11 rows of seats need not be provided with aisles if the vertical distance between seats does not exceed twelve inches (12").

Aisles shall be not less than three feet six inches (3'6") in width.

There shall be not more than nine seats between any seat and an aisle.

The width of cross-aisles and aisles to exitways shall be as specified in Section 3313.

Where bleacher sections are placed on platforms above the main floor, a cross-aisle and guard railing shall be provided at the front of such sections.

Open end sections shall be provided with railings for that portion above the fourth row of seats. Where the back of a bleacher section is not placed against a wall, a railing shall be provided at the back of the section.

Any increase of occupant load because of the addition of bleachers shall require additional exit facilities.

Exits: Group A Occupancies

Sec. 3316. (a) **Main Exit.** Every Group A occupancy shall be provided with a main exit.

The main exit shall be of sufficient width to accommodate one-half the total occupant load but shall not be less than the total width of all aisles and stairways leading thereto and shall connect to a stairway or ramp leading to a public way.

Steps may be used if separated from the main exit by a landing not less in area than the foyer.

(b) **Side Exits.** Every auditorium and balcony of a Group A occupancy shall be provided with exits on each side. The exits on each side of the auditorium or balcony shall be of sufficient width to accommodate one-third of the total occupant load served. Side exits shall open directly into an exit court or a ramp leading to an exit court, except that side exits from a balcony may lead to a stairway, and side exits from balconies above the first balcony shall be by way of a stairway or ramp in a smokeproof enclosure. Side exits shall be accessible from a cross aisle or a side aisle.

(c) **Panic Hardware.** An exit door from a Group A occupancy having an occupant load of more than 50, shall not be provided with a latch or lock unless it is panic hardware.

Exits: Group B Occupancies

Sec. 3317. (a) **Group B, Divisions 1 and 2.** Divisions 1 and 2 occupancies shall have exits as required by Section 3315.

(b) **Group B, Divisions 3 and 4.** An exit door from any Group B occupancy, Divisions 3 and 4, having an occupant load of more than 50, shall not be provided with a latch or lock unless it is panic hardware.

Exits: Group C Occupancies

Sec. 3318. (a) **Corridors.** The width of a corridor in a Group C occupancy shall be the width required by Section 3302 plus two feet (2'), but no corridor shall be less than six feet (6') wide.

Exits: Group C Occupancies (Cont'd.)

Corridor walls and ceilings shall be of not less than one-hour fire-resistive construction.

There shall be no change of elevation of less than two feet (2′) in a corridor unless ramps are used.

(b) **Corridors Serving Auditoriums.** An exit serving both an auditorium and other rooms need provide only for the capacity of whichever requires the greater width if the auditorium is not to be used simultaneously with the other rooms.

(c) **Stairs.** Each floor above or below the ground floor level shall have not less than two exit stairs and the required exit width shall be equally divided between such stairs, provided that no stair serving an occupant load of more than 100 shall be less than five feet (5′) in width exclusive of rails.

EXCEPTION: This subsection does not apply to rooms used for maintenance, storage, and similar purposes.

(d) **Doors.** The width of exit doors from corridors, halls and stairs shall be not more than two feet (2′) narrower than the required width of such corridors, halls, or stairs.

Exit doors in schoolrooms shall swing in the direction of egress.

(e) **Exterior Exit.** Any room, the floor of which is below grade and which is used by pupils shall have at least one exit leading directly to the exterior of the building, and such exit shall be not less in width than one-half the required aggregate width of exits from such room.

(f) **Self-Releasing Device.** Exit doors from rooms having an occupant load of more than 100 and from corridors shall not be provided with a latch or lock unless it is panic hardware.

Exits: Group D Occupancies

Sec. 3319. (a) **Separate Exits.** Every room in a Group D occupancy shall have access to two separate exits.

(b) **Corridors.** There shall be no change of elevation of less than two feet (2′) in a corridor unless ramps are used.

The corridors shall be not less than eight feet (8′) wide in occupancies where bedridden patients are housed.

(c) **Basement Exits.** One exit from every room below grade shall be to the exterior.

(d) **Ramps.** Every portion of a Group D occupancy, Division 2, in buildings of Types II, III, IV, and V housing bedridden patients, shall have access to a horizontal exit or a ramp leading to the exterior.

(e) **Doors.** Exit doors serving areas housing bedridden patients shall be not less than three feet six inches (3′6″) in width.

(f) **Locks.** No exterior door shall be lockable from the inside, except in sanitariums for mental patients.

(g) **Places of Detention.** No requirements of this Chapter shall be so construed as to prohibit the construction of cell blocks in jails or prevent the use of any locks or safety devices in buildings conforming to the provisions of this Code where it is necessary forcibly to restrain the inmates.

(h) **Exceptions.** Where construction meets the require-

ments of Section 902 (b), the exterior doors may be fastened with locks, provided that room doors shall not be fastened by other means than doorknobs or similar devices which can be opened readily from the corridor side without the use of keys. **Exits: Group D Occupancies (Cont'd.)**

Sec. 3320. Every portion of a Group E occupancy having a floor area of two hundred square feet (200 sq. ft.) or more shall be served by at least two separate exits. **Exits: Group E Occupancies**

Sec. 3321. (a) **Boiler Rooms.** Every boiler room and every room, except in Group I occupancies, containing an oil-fired furnace or incinerator shall be provided with at least two means of exit, one of which may be a ladder. **Special Hazards**

(b) **Cellulose Nitrate Handling.** Film laboratories, projection rooms, and nitrocellulose processing rooms shall have not less than two exits.

CHAPTER 34—DOORS, WINDOWS AND SKYLIGHTS

Doors and Windows

Sec. 3401. Fire doors and windows where required shall be as specified in Section 4306.

Skylights

Sec. 3402. All skylights constructed with metal frames shall be substantially built with interlocking seams. Frames of skylights shall be designed to carry loads required for roofs as specified in Section 2305. All skylights, the glass of which is set at an angle of less than 45 degrees from the horizontal, if located above the first story, shall be set at least one foot (1′) above the roof. The curbs on which the skylight rests shall be constructed as required for inner court walls or for masonry.

Spacing between supports for flat wired glass in skylights shall not exceed twenty-five inches (25″). Corrugated wired glass may have supports five feet (5′) apart in the direction of the corrugation. All glass in skylights shall be wire glass, except that skylights over vertical shafts extending through two or more stories shall be glazed with plain glass as specified in this Section; provided, that wire glass may be used if ventilation equal to not less than one-eighth the cross-sectional area of the shaft but never less than four feet (4′) is provided at the top of such shaft.

Any glass not wire glass shall be protected above and below with a screen constructed of wire not smaller than No. 12 B. and S. gauge with a mesh not larger than one inch (1″). The screen shall be substantially supported below the glass.

Skylights installed for the use of photographers may be constructed of metal frames and plate glass without wire netting.

Ordinary glass may be used in the roofs and skylights for greenhouses, provided the height of the greenhouse at the ridge does not exceed twenty feet (20′) above the grade. The use of wood in the frames of skylights will be permitted in greenhouses outside of Fire Zones No. 1 and 2, if the height of the skylight does not exceed twenty feet (20′) above the grade, but in other cases metal frames and metal sash bars shall be used.

Glass used for the transmission of light, if placed in floors or sidewalks, shall be supported by metal or reinforced concrete frames, and such glass shall be not less than one-half inch (½″) in thickness. Any such glass over sixteen square inches (16 sq. in.) in area, shall have wire mesh embedded in the same or shall be provided with a wire screen underneath as specified for skylights in this Section. All portions of the floor lights or sidewalk lights shall be of the same strength as is required by this Code for floor or sidewalk construction, except in cases where the floor is surrounded by a railing not less than three feet six inches (3′6″) in height, in which case the construction shall be calculated for not less than roof loads.

CHAPTER 35—BAYS, PORCHES AND BALCONIES

Bay and Oriel Windows

Sec. 3501. Construction of walls and floors in bay and oriel windows shall conform to the construction allowed for exterior walls and floors of the type of construction of the building to which they are attached. The roof covering of a bay or oriel window shall conform to the requirements for roofing of the main roof of the building.

Balconies and Porches

Sec. 3502. Exterior balconies attached to or supported by masonry shall have brackets or beams constructed of incombustible material. Railings for balconies or porches shall be not less than three feet (3′) in height above the floor of such balcony or porch.

Porches and exterior balconies may be constructed of the materials allowed for the building to which they are attached, but structural steel or iron members need not be fire-protected.

CHAPTER 36—PENTHOUSES AND ROOF STRUCTURES

Penthouses and Roof Structures

Sec. 3601. No penthouse or other projection above the roof in structures of other than Type I construction shall exceed twenty-eight feet (28′) in height above the roof when used as an enclosure for tanks or for elevators which run to the roof and in all other cases shall not extend more than twelve feet (12′) in height above the roof. The aggregate area of all penthouses and other roof structures shall not exceed 20 per cent of the area of the supporting roof. No penthouse, bulkhead or any other similar projection above the roof shall be used for manufacturing or storage.

Roof structures of Type I and II buildings shall be constructed with walls, floors and roof as required for the main portion of the building.

EXCEPTION: Exterior walls and roofs of penthouses which are five feet (5′) or more from the face of the exterior walls of the building may be of one-hour fire-resistive construction.

Walls of roof structures parallel to and within four feet (4′) of the exterior walls of Type III buildings shall be constructed the same as the exterior wall of the story immediately below. Such wall shall project two feet (2′) above the roof and two feet (2′) beyond the sides of such roof structure, except that the side projection shall not be required when the adjoining side walls are of masonry. Walls other than those occurring within four feet (4′) of an exterior wall on Type III buildings shall be of not less than one-hour fire-resistive construction. The restrictions of this paragraph shall not prohibit the placing of wood flagpoles or similar structures on the roof of any building.

Towers and Spires

Sec. 3602. Towers or spires when enclosed shall have exterior walls as required for the building to which they are attached. Towers not enclosed and which extend more than seventy-five feet (75′) above grade shall have their framework constructed of iron, steel or reinforced concrete. No tower or spire shall occupy more than one-fourth of the street frontage of any building to which it is attached and in no case shall the base area exceed sixteen hundred square feet (1600 sq. ft.) unless it conforms entirely to the type of construction requirements of the building to which it is attached and is limited in height as a main part of the building. If the area of the tower or spire exceeds one hundred square feet (100 sq. ft.) at any horizontal cross section, its supporting frame shall extend directly to the ground. The roof covering of spires shall be as required for the main roof of the rest of the structure.

Skeleton towers used as radio masts and placed on the roof of any building shall be constructed entirely of incombustible materials when more than twenty-five feet (25′) in height and shall be directly supported on an incombustible framework to the ground. They shall be designed to withstand a wind load from any direction as specified in Section 2307 in addition to any other loads.

CHAPTER 37—CHIMNEYS, FLUES, VENTS AND FIREPLACES

Scope

Sec. 3701. (a) **General.** Chimneys, flues, vents and fireplaces, and their connections, carrying products of combustion, shall conform to the requirements of this Chapter.

(b) **Equipment and Appliances.** Equipment and appliances shall be of approved types and shall be installed in full compliance with the conditions of approval, special limitations of use, and the manufacturer's instructions.

Definitions

(c) **Definitions. APPLIANCES, HIGH HEAT,** are any installation or equipment in which the temperature of the flue gases as they enter the flue is above 1500° F. to be measured at the outlet of the appliance or at the outlet of the draft hood attached to the appliance.

APPLIANCES, LOW HEAT, are any installation or equipment in which the temperature of the flue gases is up to 550° F. to be measured at the outlet of the appliance or at the outlet of the draft hood attached to the appliance.

APPLIANCES, MEDIUM HEAT, are any installation or equipment in which the temperature of the flue gases as they enter the flue is between 550° F. to 1500° F. to be measured at the outlet of the appliance or at the outlet of the draft hood attached to the appliance.

CHIMNEYS, FLUES or **VENTS** are conduits or passageways, vertical or nearly so, for conveying products of combustion to the outer air.

1. **Type A.** Chimneys, flues or vents of masonry, reinforced concrete, metal smoke stacks and approved special flues.

2. **Type B.** Flues or vents of non-combustible, corrosion-resistant material of sufficient thickness, cross-sectional area, and heat insulating quality to avoid excess temperature on adjacent combustible material and certified by a nationally recognized agency.

3. **Type C.** Flues or vents of sheet copper of not less than No. 24 gauge U.S. Standard or of galvanized iron of not less than No. 20 gauge U.S. Standard or of other approved corrosion-resistant material.

FIREBRICK is any refractory fire-clay brick which meets U.B.C. Standard No. 37-1.

FIRE-CLAY FLUE LINING is flue lining made of materials conforming to the definition of fire clay as described in U.B.C. Standard No. 37-2.

FLUE OR VENT CONNECTOR is the pipe connecting a low heat appliance with the flue or vent.

SMOKE PIPE is the pipe connecting a medium or high heat appliance with the flue or vent.

VENT (See definition for Chimneys, Flues, or Vents).

Chimneys

Sec. 3702. (a) **Structural Design.** Chimneys shall be designed, anchored, supported, and reinforced when so designed as required in this Chapter and Chapters 23 and 28. No chimney shall support any structural load other than its own weight. Chimneys in wood frame buildings shall be anchored laterally at the ceiling line and at each floor line which is more than six feet (6') above grade, except when entirely within the framework.

(b) **Walls.** Every chimney shall have solid masonry or reinforced concrete walls at least eight inches (8") thick in addition to the lining of fire-clay flue lining or firebrick.

EXCEPTION: Chimneys not exceeding thirty feet (30') in height and serving medium heat appliances may have a fire-clay flue lining surrounded by four inches (4") of brick. (See Section 3713 for Fireplaces and their Chimneys).

(c) **Flue Lining.** Fire-clay flue lining shall be not less than five-eighths inches (⅝") thick. The lining shall extend from eight inches (8") below the lowest inlet or, in the case of fireplaces, from the throat of the fireplace to a point at least four inches (4") above enclosing masonry walls. Fire-clay flue linings shall be installed ahead of the construction of the chimney as it is carried up, carefully bedded one on the other in fire-clay mortar, with close-fitting joints left smooth on the inside. Firebrick may be used in place of fire-clay flue lining and shall be not less than two inches (2") thick.

(d) **Flue Area.** No flue shall be smaller in area than the flue connection on the appliance attached thereto nor less than as set forth in Table No. 37-A.

(e) **Height.** Every chimney shall extend at least two feet (2') above the part of the roof through which it passes and at least two feet (2') above the highest elevation of any

TABLE NO. 37-A—FLUE AREA FOR SOLID OR LIQUID FUELS

TYPE OF EQUIPMENT	MINIMUM AREA OF FLUE		
	LINED		UNLINED
	ROUND	RECTANGLE	
Small stoves and heaters	28 sq. in.	35 sq. in. 8" x 8"	64 sq. in.
Ranges and room heaters	40 sq. in.	57 sq. in. 8" x 12"	85 sq. in.
Fireplaces	1/12 of opening — minimum 50 sq. in.	1/10 of opening — minimum 64 sq. in.	1/8 of opening — minimum 100 sq. in.
Warm air furnaces or boilers	70 sq. in.	87 sq. in. 12" x 12"	135 sq. in.

Note: For altitudes over two thousand feet (2,000') above sea level the Building Official shall be consulted in determining the area of the flue.

part of the building within ten feet (10') of the chimney. The Building Official may approve a chimney of lesser height installed with an approved vent cowl having a spark arrester whose opening shall be not less than six feet (6') from any part of the building measured horizontally. For altitudes over two thousand feet (2,000') the Building Official shall be consulted in determining the height of the chimney. **Chimneys (Cont'd.)**

(f) **Corbeling.** No chimney shall be corbeled from a wall more than six inches (6"); nor shall a chimney be corbeled from a wall which is less than twelve inches (12") in thickness unless it projects equally on each side of the wall. In the second story of a two-story building of Group I occupancy, corbeling of chimneys on the exterior of the enclosing walls may equal the wall thickness. In every case the corbeling shall not exceed one inch (1") projection for each course of brick.

(g) **Change in Size or Shape.** No change in the size or shape of a chimney where the chimney passes through the roof shall be made within a distance of six inches (6") above or below the roof joists or rafters.

(h) **Separation of Chimney Liners.** When more than one flue or vent is contained in the same chimney, masonry separation at least four inches (4") thick bonded into the masonry wall of the chimney shall be provided to separate flues in pairs or singly.

(i) **Inlets.** Every inlet to any chimney shall enter the side thereof and shall be of not less than one-eighth inch (⅛") thick metal or five-eighths inch (⅝") thick refractory material.

(j) **Clearance.** Combustible material shall not be placed within two inches (2") of smoke chambers, or chimneys when built entirely within a structure, or within one inch (1") when the chimney is built entirely outside the structure. For special conditions covering fireplaces see Sec. 3713.

(k) **Incinerators.** Masonry chimneys for incinerators in buildings of Group I occupancy shall be lined with fireclay flue lining and shall have walls of not less than four inches (4") of solid masonry or reinforced concrete. Chimneys for incinerators using the flue as a refuse chute where the horizontal grate area of combustion chamber does not exceed nine square feet (9 sq. ft.), shall have walls of solid masonry or reinforced concrete, not less than four inches (4") thick with a flue lining as specified in Subsection (c) of this Section. If the grate area of such an incinerator exceeds nine square feet (9 sq. ft.), walls shall be not less than four inches (4") thick and shall be lined with not less than four inches (4") of firebrick, except that higher than thirty feet (30') above the roof of the combustion chamber, common brick alone, eight inches (8") in thickness, may be used.

Chimneys for commercial and industrial type incinerators of a size designed for more than 250 pounds of refuse per hour and having a horizontal grate area not exceeding nine square feet (9 sq. ft.) shall have walls of solid masonry or reinforced concrete not less than four inches (4") thick,

with lining of not less than four inches (4") of firebrick, which lining shall extend for not less than forty feet (40') above the roof of the combustion chamber. If the design capacity or grate area of such an incinerator exceeds 250 pounds per hour and nine square feet (9 sq. ft.) respectively, walls shall be not less than eight inches (8") thick, lined with not less than four inches (4") of firebrick extending for the full height of the flue.

All incinerator chimneys shall terminate in a substantially constructed spark arrester having a mesh not exceeding three-quarters inch (¾").

Commercial and Industrial Chimneys

Sec. 3703. (a) **Low Heat Appliances.** Masonry chimneys serving low heat appliances shall be lined with fire-clay flue lining or firebrick and have walls of solid masonry or reinforced concrete not less than eight inches (8") in thickness.

(b) **Medium Heat Appliances.** Masonry chimneys serving medium heat appliances other than incinerators shall be of solid masonry or reinforced concrete not less than eight inches (8") in thickness and shall be lined with not less than four inches (4") of firebrick laid in fire-clay mortar, starting not less than two feet (2') below the smoke pipe entrance and extending for a distance of at least twenty-five feet (25') above the smoke pipe entrance.

(c) **High Heat Appliances.** Masonry chimneys serving high heat appliances shall be built with double walls, each not less than eight inches (8") in thickness with an air space of not less than two inches (2") between them. The inside of the interior walls shall be of firebrick not less than four inches (4") in thickness laid in fire-clay mortar or refractory cement.

Chimneys of cupola furnaces, blast furnaces and similar devices hereafter erected, shall extend at least twenty feet (20') above the highest point of any roof within a radius of fifty feet (50') thereof. No woodwork or other combustible material or construction, whether protected or unprotected, shall be erected or placed within three feet (3') of any part of such chimney.

Metal Smokestacks

Sec. 3704. (a) **Thickness.** Metal smokestacks shall be designed and constructed as specified in Chapter 27.

(b) **Construction and Support.** Metal smokestacks shall be properly riveted or welded and, unless structurally self-supporting, shall be guyed securely, or firmly anchored to or otherwise supported by the building or structure served thereby.

Metal smokestacks used for high heat appliances shall be lined with four inches (4") firebrick laid in fire-clay mortar extending not less than twenty-five feet (25') above the smoke pipe entrance.

(c) **Height.** Metal smokestacks shall extend to a height of not less than ten feet (10') above the elevation of any part of a roof within twenty-five feet (25').

(d) **Clean-outs.** Clean-out openings shall be provided at the base of every metal smokestack.

(e) **Exterior Stacks.** Metal smokestacks, or parts thereof, erected on the exterior of a building shall have a clear-

ance of twenty-four inches (24") from combustible walls and four inches (4") from incombustible walls. No such stack shall be nearer than twenty-four inches (24") in any direction from a door, window, or other wall opening or from an exit. **Metal Smokestacks (Cont'd.)**

(f) **Interior Stacks.** Metal smokestacks, or parts thereof, in a building other than a one-story building, shall be enclosed above the story in which the appliance served thereby is located, in walls of incombustible construction having a fire-resistance rating of not less than one hour, with a space on all sides between the stack and the enclosing walls sufficient to render the entire stack accessible for examination and repair.

The enclosing walls shall be without openings, except doorways equipped with approved self-closing fire doors of Class "B" type or better at various floor levels for inspection purposes. Where such a stack passes through a roof constructed of combustible materials, it shall be guarded by a galvanized iron ventilating thimble extending not less than nine inches (9") below and nine inches (9") above such roof construction. Such thimbles shall be of a size to provide a clearance on all sides of the stack of not less than eighteen inches (18"); provided that for stacks of low heat appliances, the clearance may be reduced to not less than six inches (6"). Smokestacks shall not be carried up inside of ventilating ducts unless such ducts are constructed as required by this Section for smokestacks or smoke flues and such stacks or flues are used solely for venting the room or space in which the appliance served by the smokestack is located.

Sec. 3705. Type A flues or vents shall consist of chimneys, metal smokestacks and approved special flues. Type A flues or vents shall be required for (1) solid and liquid fuel burning heating equipment, and (2) gas-burning equipment which produces flue gas temperatures in excess of 550° F. at the outlet of the appliance or the draft hood when burning gas at the input rating specified by the manufacturer of such equipment. **Type A Flues or Vents**

Sec. 3706. (a) Type B flues or vents shall consist of approved vent piping of incombustible, corrosion-resistant material of sufficient thickness, cross-sectional area and heat insulating quality to avoid excess temperature on any adjacent combustible material as determined by tests made by a recognized testing laboratory. **Type B Flues or Vents**

(b) Type B flues or vents may be used only to vent gas-fired appliances approved for maximum flue gas temperature of 550° F. at the outlet of the appliance or the draft hood. (See Chapter 51, Appendix).

(c) **Installation.** 1. **Joints.** Type B flues or vents shall be made up with tight joints. Flue pipe cement if used shall be acid resisting.

2. **Clearances.** Type B flues or vents shall be installed with a clearance to combustible material of not less than one inch (1") or otherwise flues or vents shall be located in such a manner that continued operation of the appliance will not raise the temperature of surrounding combustible con-

Type B Flues or Vents (Cont'd.)

struction more than 90° F. above normal room temperature when measured with a mercury thermometer or conventional bead-type thermocouples.

Flue or vent piping requiring a clearance greater than one inch (1") to avoid excess temperature on adjacent combustible material, or which require ventilated clearances, shall be installed in accordance with the conditions of approval and listing by the testing laboratory.

Flue or vent piping approved for less than one inch (1") clearance from combustible materials may be installed in accordance with the conditions of approval and listing by the testing laboratory.

3. **Protection Against Injury.** Suitable provision shall be made to prevent mechanical injury to Type B flues and vents where they extend through walls, floors or roof.

4. **Support.** Flue or vent piping shall be supported at each joint.

5. **Size.** The gravity flue or vent to which the flue or vent connector is connected shall be of a size not less than the flue collar on the appliance attached thereto. In no case shall the area be less than the area of four-inch (4") diameter pipe. When more than one appliance vents into a flue or vent, the flue or vent area shall be not less than the area of the largest flue or vent connector plus 50 per cent of the areas of the additional flue or vent connectors. An oval flue or vent may be used provided its flue gas venting capacity is equal to the capacity of round pipe for which it is substituted. Unless specified by the manufacturer of appliance and approved by the Building Official, no damper shall be installed in any gas vent or flue.

6. **Height.** Each gas vent shall extend above the roof surface and through its flashing and shall terminate in an approved cap with a venting capacity not less than that of the vent. The outlet opening of any such vent shall be not less than twelve inches (12") from any portion of the building, nor less than four feet (4') from any of that portion of the building or structure which extends at an angle of more than 45 degrees upward from the horizontal. No such vent outlet shall terminate less than four feet (4') from or one foot (1') above any door, window, or air intake.

7. **Offset.** A single portion of any flue or vent may extend at an angle of not more than 60 degrees from the vertical.

Type C Flues or Vents

Sec. 3707. (a) Where Type A or Type B flues or vents are not required, Type C flues or vents may be used provided they meet the limitations of use as specified in this Section.

(b) **General.** Type C flues or vents shall be used only for runs directly from the space in which the appliance is located through a roof to the outer air without passing through any attic, concealed space, or floor. No such vent shall extend more than three feet (3') above the roof through which it passes.

(c) **Clearances.** 1. Clearances between Type C flues or

vents and combustible material shall be not less than six inches (6") when used with approved appliances except warm air heating furnaces.

2. Clearances between Type C flues or vents and combustible material shall be not less than nine inches (9") when used with untested appliances or warm air heating furnaces.

3. Combustible walls, partitions, and roofs through which Type C flues or vents pass shall be protected at the point of passage by one of the following methods:

a. By metal ventilated thimbles not less than six inches (6") larger in diameter than the flue or vent pipe.

b. By metal thimbles not less than four inches (4") larger in diameter than the pipe with the annular space filled with mineral wool or other approved non-combustible insulating material.

(d) A single portion of any flue or vent may extend at an angle of not more than 60° from the vertical.

Special Type "A" Flues or Vents

Sec. 3708. (a) Special Type "A" flues or vents shall be of approved types and shall be installed in full compliance with the conditions of approval, special limitations of use, and the manufacturer's instructions.

(b) **Terra Cotta Chimneys.** Subject to the approval of the Building Official, terra cotta chimneys may be installed in buildings of Group I occupancy and shall comply with the requirements of this Section.

1. **Construction.** Terra cotta chimneys erected on the exterior of a building shall be not less than six inches (6") from all combustible material, except that when encased in an incombustible casing they shall be not less than two inches (2") from combustible materials, as specified in Subsection (b)4. Such chimneys shall be exposed to view for the full length, and if erected in the interior of a building shall be encased in an incombustible casing so arranged as to provide not less than one inch (1") air space between the chimneys and the casing. Such air space shall have ventilating openings top and bottom.

2. **Anchorage.** Terra cotta chimneys shall be anchored each six feet (6') of their height. Such anchorage shall be designed to withstand a load of not less than 200 pounds applied in any direction.

3. **Support.** Exterior terra cotta chimneys shall be supported directly on their own foundation or upon an incombustible support. Interior terra cotta chimneys shall not be supported on brackets but shall be carried on the floor system or directly on their own foundations.

4. **Protection.** Incombustible casings of terra cotta chimneys specified in Subsection (b)2. shall be not less than two inches (2") from combustible materials. When terra cotta chimneys are enclosed, the enclosures shall have ventilating openings at both top and bottom. The support for such chimney shall be protected by four inches (4") of incombustible material in the bottom of the flue.

Smoke Pipes

Sec. 3709. (a) **Materials.** Smoke pipes serving fixed appliances shall be of substantial metal construction, but never less than No. 22 gauge U.S. Standard. Smoke pipes serving portable appliances shall be of not less than No. 30 gauge U.S. Standard.

(b) **Smoke Pipe Connections.** Two or more smoke pipes shall not be joined to a single flue or vent unless the common smoke pipe and flue or vent is of sufficient size to serve all the appliances thus connected. The smoke pipe of a heating appliance shall not be connected into the flue or vent of an incinerator which has the rubbish chute identical with the smoke flue.

No flue or vent shall have smoke pipe connections in more than one story of a building, unless provision is made for effectively closing smoke pipe openings with devices made of incombustible materials whenever their use is discontinued temporarily, and completely closing them with masonry when discontinued permanently. Smoke pipes shall be exposed to view throughout their entire length.

(c) **Clearances.** Clearances between smoke pipes and combustible material shall be eighteen inches (18") when used on low heat appliances and thirty-six inches (36") when used on medium heat appliances. These clearances may be reduced as set forth in Table No. 51-A.

Flue or Vent Connectors

Sec. 3710. (a) **Materials.** Flue or vent connectors shall be of galvanized or copper-bearing steel of not less than 26 gauge U.S. Standard, terra cotta, asbestos-cement, or other approved durable material and shall be exposed to view throughout their entire length. Flue or vent connectors serving portable appliances shall be not less than 30 gauge U.S. Standard.

(b) **Size.** Flue or vent connectors shall be not less in diameter than the flue or vent outlet in the appliance.

(c) **Pitch.** Flue or vent connectors, serving appliances other than water heaters, shall have a rise of not less than one-half inch (½") to the foot.

(d) **Length and Support.** The horizontal projected length of the flue or vent connector shall not exceed 75 per cent of the vertical projected length of the flue or vent. Horizontal runs shall be as short and as direct as possible. Connectors shall be securely supported at each joint.

(e) **Connection to Flue or Vent.** Flue or vent connectors which enter flues or vents installed in exterior walls or outside of buildings shall be connected by means of tees. Where atmospheric conditions require, provision for removal of condensate shall be provided. Any two inlets shall be separated vertically by not less than the diameter of the larger inlet.

(f) **Clearances.** 1. Clearances between Type C flue or vent connectors and combustible material shall be not less than those specified for Type C flues or vents in Subsection 3707 (c), paragraphs 1 and 2.

Clearances between Type B flue or vent connectors shall

be not less than those specified for Type B flues or vents in Subsection 3706 (c), paragraph 2.

2. **Location.** All gas appliances connected to the common vent shall be located in the same story of the building.

Interconnection of Vents

Sec. 3711. No flue or vent connector from a gas appliance shall be interconnected with any other flue or vent connector, smoke pipe, or flue, unless such gas appliances are equipped with an automatic device to prevent the escape of unburned gas at the main burner or burners. Where a gas appliance flue or vent connector is joined with a smoke pipe from an appliance burning some other type of fuel for connection into a single flue opening, they shall be joined by a Y-fitting located as close as practicable to the chimney. With liquefied petroleum gases the automatic device to prevent the escape of unburned gas shall shut off the pilot light as well as the main burner or burners.

Water Heater Vents

Sec. 3712. Every gas water heater shall have an entirely separate and independent vent, except that not more than four gas water heaters may be connected to a common vent manifold if constructed and installed in accordance with the following additional requirements:

1. **Location.** All water heaters connected to the common vent shall be located in the same story of the building.

2. **Vent Manifold Required.** If more than three feet (3′) of vent connector is required to connect a water heater to the common vent, the water heater shall be connected to a vent manifold.

3. **Length of Vent Manifold.** The length of the vent manifold shall be not greater than 75 per cent of the height of the vertical vent to which it connects, nor shall the length of the vent manifold exceed fifteen feet (15′).

4. **Slope.** Vent manifold and vent connections shall slope upward toward the vent at a rate of not less than one inch (1″) per foot of length.

5. **Connections.** The connection between any heater and a vent manifold shall not exceed three feet (3′) in length. Vent connections shall approach and intersect the vent manifold so that the flow of the products of combustion will converge at an angle of not more than 45°.

6. **Size of Vent.** The size of the common vent and the vent manifold shall be not less than the values set forth in Table No. 37-B.

TABLE NO. 37-B—VENT AND VENT MANIFOLD FOR GAS HEATERS

NUMBER OF GAS WATER HEATERS	MAXIMUM GAS INPUT RATING OF ALL GAS WATER HEATERS	MINIMUM INTERNAL DIAMETER OF VENT AND VENT MANIFOLD (Inches)
2 or 3	75,000 B.t.u.	5
4	100,000 B.t.u.	6
4	200,000 B.t.u.	7
4	300,000 B.t.u.	8

Fireplaces

Sec. 3713. (a) Fireplaces, smoke chambers and fireplace chimneys, shall be of solid masonry or reinforced concrete and shall conform to the following minimum requirements:

1. **Fireplace Walls.** Structural walls of fireplaces shall be not less than eight inches (8") in thickness. Back walls of fireboxes shall be not less than ten inches (10") in thickness, except that where a lining of firebrick is used such back walls shall be not less than eight inches (8") in thickness.

2. **Metal Heat Circulators.** Approved metal heat circulators may be installed in fireplaces.

3. **Smoke Chamber** front and side walls shall be not less than eight inches (8") in thickness. Smoke chamber back walls shall be not less than six inches (6") in thickness.

4. **Fireplace Chimney Walls** shall be not less than eight inches (8") in thickness, or when lined with fire-clay flue lining, not less than four inches (4") in thickness. See Sec. 3702 (c).

5. **Clearance.** Combustible material shall not be placed within two inches (2") of fireplaces, smoke chambers, or chimneys when built entirely within a structure, or within one inch (1") when the chimney is built entirely outside the structure. Combustible materials shall not be placed within six inches (6") of the fireplace opening. No such combustible material within twelve inches (12") of the fireplace opening shall project more than one-eighth inch (⅛") for each one-inch (1") clearance from such opening.

6. **Areas of Flues, Throats and Dampers.** The net cross-sectional area of the flue and of the throat between the firebox and the smoke chamber of a fireplace shall be not less than as set forth in Table No. 37-A. Where dampers are used, damper openings shall be not less in area, when fully opened, than the required flue area.

7. **Lintel.** Masonry over the fireplace opening shall be supported by an incombustible lintel.

8. **Hearth.** Every fireplace shall be provided with a brick, concrete, stone or other approved incombustible hearth slab at least twelve inches (12") wider on each side than the fireplace opening and projecting at least twenty inches (20") therefrom. This slab shall be not less than four inches (4") thick and shall be supported by incombustible materials or reinforced to carry its own weight and all imposed loads. Combustible forms and centering shall be removed.

9. **Firestopping.** Firestopping between chimneys and wooden construction shall meet the requirements of Section 2522.

10. **Non-Conforming Fireplaces.** Imitation and other fireplaces not conforming to the other requirements of this Section shall not exceed six inches (6") in depth. Gas-burning appliances may be installed in such non-conforming fireplaces provided that compliance is made with the requirements of this Chapter on flues or vents and clearances from combustible materials in Chapter 51, Appendix.

11. **Support.** Fireplaces shall be supported on foundations designed as specified in Chapters Nos. 23, 24 and 28.

CHAPTER 38—FIRE-EXTINGUISHING SYSTEMS

Automatic Fire-Extinguishing Systems: Where Required

Sec. 3801. Standard automatic fire extinguishing systems shall be installed as specified in this Chapter in the following places:

1. In every story or basement of a building when the floor area exceeds fifteen hundred square feet (1500 sq. ft) and there is not provided at least twenty square feet (20 sq. ft.) of opening in each fifty (50) lineal feet or fraction thereof of exterior wall in the story or basement on at least one side of the building. Openings shall have a minimum dimension of not less than thirty inches (30").
2. In all cellars in Group A and B occupancies and in other cellars when the floor area exceeds fifteen hundred square feet (1500 sq. ft.).
3. In the following locations in Group A occupancies and Divisions 1 and 2, Group B occupancies having a stage or enclosed platform:
   A. In all dressing room sections, workshops and storerooms.
   B. Where there is a stage; under the gridiron, stage floor, tie and fly galleries, and in all places back of the proscenium wall.
   C. Over enclosed platforms having an area of more than one thousand square feet (1000 sq. ft.) and over any usable space under such platforms.
4. In any enclosed occupied space in Groups B, C, and D occupancies below or over a stairway, except where the entire construction is as required for Type I or II buildings, and in all portions of basements or cellars used for storage or maintenance work rooms.
5. In Divisions 1 and 2, Group E occupancies having an area of more than fifteen hundred square feet (1500 sq. ft.); in Division 3, Group E occupancies having an area of more than three thousand square feet (3000 sq. ft.); and in Division 4, Group E occupancies more than one story in height.

Detailed Requirements

Sec. 3802. Required automatic fire-extinguishing systems shall comply in all respects with the regulation of U.B.C. Standards No. 38-1 or No. 38-2.

EXCEPTIONS: 1. A single water supply equal to the primary supply required by such regulations may be accepted as complying with the requirements of this Code.

In no case where a connection to a city water main constitutes the source of supply shall such connection be less than four inches (4") in diameter.

2. Sprinklers required in paragraph 5, Section 3801, may be supplied from the domestic water system and need not comply with the provisions of this Section except as to pipe sizes and spacing of heads, provided that where the domestic water supply has a pressure less than 15 pounds per square inch, an approved automatic chemical extinguisher may be used in lieu of the sprinklers.

Detailed Requirements (Cont'd.)

3. The alarm valve required for a standard automatic fire extinguishing system shall not be required in the cellars of Groups B, C, D, E, F, G, and H occupancies where the area of such cellar is less than three thousand square feet (3000 sq. ft.).

Dry Standpipes; Where Required

Sec. 3803. Every building four or more stories in height shall be equipped with one or more dry standpipes.

Dry Standpipes; Detailed Requirements

Sec. 3804. (a) **Construction.** Dry standpipes shall be of wrought iron or galvanized steel and together with fittings and connections shall be of sufficient strength to withstand 300 pounds of water pressure to the square inch when ready for service, without leaking at the joints, valves or fittings.

Tests shall be conducted by the owner or contractor in the presence of a representative of the Fire Department whenever deemed necessary and ordered by the Building Official. The tests shall be applied at the top and bottom connections of such standpipes and the owner or contractor shall be responsible for any damage caused by breakage or faulty installation while such tests are being conducted. After such standpipes have been tested, the owner or contractor shall remove all water therefrom.

(b) **Size.** Dry standpipes shall be of such a size as to be capable of delivering 250 gallons per minute from each of any three outlets simultaneously under the pressure created by one fire engine or pumper, based on the existing city equipment available. No part of a dry standpipe system other than hose connections shall be less than three inches (3") in diameter.

(c) **Number Required.** Every building four or more stories in height where the area of any floor above the third floor is ten thousand square feet (10,000 sq. ft.) or less shall be equipped with not less than one dry standpipe and an additional standpipe shall be installed for each additional ten thousand square feet (10,000 sq. ft.) or fraction thereof.

(d) **Location.** Standpipes shall be located within stairway enclosures or as near such stairways as possible or shall be on the outside of, embedded within, or immediately inside of an exterior wall and within one foot (1') of an opening in a stairway enclosure or the balcony or vestibule of a smokeproof tower or an outside exit stairway.

(e) **Siamese Connections.** All four-inch (4") dry standpipes shall be equipped with a two-way Siamese fire department connection. All five-inch (5") dry standpipes shall be equipped with a three-way Siamese fire department connection and all six-inch (6") dry standpipes shall be equipped with a four-way Siamese fire department connection. All Siamese inlet connections shall be located on a street front of the building and not less than one foot (1') nor more than four feet (4') above the grade and shall be equipped with clapper-checks and substantial plugs. All Siamese inlet connections shall be recessed in the wall or otherwise substantially protected.

(f) **Outlets.** All dry standpipes shall extend from the

ground floor to and over the roof and shall be equipped with a two and one-half inch (2½") outlet not more than four feet (4') above the floor level at each story. All dry standpipes shall be equipped with a two-way two and one-half inch (2½") outlet above the roof. All outlets shall be equipped with gate-valves with substantial chains. **Dry Standpipes (Cont'd.)**

(g) Threads. All hose threads in connection with such standpipe installations shall be uniform with that used by the local fire department.

(h) Signs. An iron or bronze sign with raised letters at least one inch (1") high shall be rigidly attached to the building adjacent to all Siamese connections and such sign shall read: "CONNECTION TO DRY STANDPIPE."

Wet Standpipes; Where Required

Sec. 3805. Every Group A and B occupancy of any height, and every Group C occupancy two or more stories in height, and every Group D, E, F, G and H occupancy three or more stories in height and every Group E and F occupancy over 20,000 square feet in area shall be equipped with one or more interior wet standpipes extending from the cellar or basement into the topmost story, provided that Group B buildings having no stage and having a seating capacity of less than 500 need not be equipped with interior standpipes.

Wet Standpipes; Detailed Requirements

Sec. 3806. **(a) Construction.** Interior wet standpipes shall be constructed as required for dry standpipes.

(b) Size. Interior wet standpipes shall have an internal diameter sufficient to deliver 50 gallons of water per minute under 30 pounds per square inch pressure at the hose connection, based on the available water supply. Buildings of Groups A and B occupancies shall have wet standpipe systems capable of delivering the required quantity and pressure from any two outlets simultaneously; for all other occupancies only one outlet need be figured to be open at one time. In no case shall the internal diameter of a wet standpipe be less than two inches (2").

Any approved formula which determines pipe sizes on a pressure drop basis may be used to determine pipe sizes for wet standpipe systems. The Building Official may require delivery and pressure tests on completed wet standpipe systems before approving such systems.

(c) Number Required. Wet standpipes shall be so located that any portion of the building can be reached therefrom with a hose not exceeding seventy-five feet (75') in length.

(d) Location. In Groups A and B occupancies, outlets shall be located as follows:

On each side of the stage, on each side of the rear of the auditorium and on each side of the rear of the balconies. Where occupant loads are less than 500 the number of locations noted above may be reduced upon the approval of the Building Official. In Groups C, D, E, F, G, and H occupancies the location of all interior wet standpipes shall be approved by the Building Official.

(e) Outlets. All interior wet standpipes shall be equipped with a one and one-half inch (1½") valve in each story including the basement or cellar of the building and located

Wet Standpipes (Cont'd.)

not less than one foot (1') nor more than five feet (5') above the floor.

(f) **Threads.** All hose threads in connection with the installation of such standpipes, including valves and reducing fittings, shall be uniform with that used by the local fire department.

(g) **Water Supplies.** All interior wet standpipes shall be connected to a street water main not less than four inches (4") in diameter, or when the water pressure is insufficient to maintain 30 pounds pressure at the highest hose outlet such standpipe shall be connected to a pressure tank, gravity tank or fire pump. Such supply shall be sufficient to furnish at least 30 pounds pressure at the topmost standpipe outlet.

When more than one interior wet standpipe is required in the building, such standpipes shall be connected at their bases or at their tops by pipes of equal size.

(h) **Pressure and Gravity Tanks.** Tanks shall have a capacity sufficient to furnish at least 250 gallons per minute for a period of not less than 10 minutes. Such tanks shall be located so as to provide not less than 25 pounds pressure at the topmost hose outlet for its entire supply. Discharge pipes from pressure tanks shall extend two inches (2") into and above the bottom of such tanks. All tanks shall be equipped with a manhole, ladder and platform, drain pipe, water and pressure gauges. Every pressure tank shall be tested in place after installation and proved tight at a hydrostatic pressure 50 per cent in excess of the working pressure required. Where such tanks are used for domestic purposes the supply pipe for such purposes shall be located at or above the center line of such tanks. Incombustible supports shall be provided for all such supply tanks and not less than a three-foot (3') clearance shall be maintained over the top and under the bottom of all pressure tanks.

(i) **Fire Pumps.** Fire pumps shall have a capacity of not less than 250 gallons per minute with a pressure of not less than 25 pounds at the topmost hose outlet. The source of supply for such pump shall be a street water main of not less than four-inch (4") diameter or a well or cistern containing a one-hour supply. Such pumps shall be supplied with an adequate source of power and shall be automatic in operation.

(j) **Hose and Hose Reels.** Each hose outlet of all interior wet standpipes shall be supplied with a hose not less than one and one-half inches (1½") in diameter. Such hose shall be equipped with a suitable brass or bronze nozzle and shall be not over seventy-five feet (75') in length. An approved standard form of wall hose reel or rack shall be provided for the hose and shall be located so as to make the hose readily accessible at all times and shall be recessed in the walls or protected by suitable cabinets.

Basement Pipe Inlets

Sec. 3807. Basement pipe inlets shall be installed in the first floor of every store, warehouse or factory where there are cellars or basements under same, except where in such cellars or basements there is installed a fire-extinguishing system as specified by this Code, or where the cellars or

basements are used for banking purposes, safe deposit vaults or similar uses.

All basement pipe inlets shall be of cast iron, steel, brass or bronze with lids of cast brass or bronze and shall consist of a sleeve not less than eight inches (8") in diameter through the floor extending to and flush with the ceiling below and with a top flange, recessed with an inside shoulder, to receive the lid and flush with the finish floor surface. The lid shall be a solid casting and have a ring lift recessed in the top thereof, so as to be flush. The lid shall have the words "Fire Department Only, Do Not Cover Up," cast in the top thereof. The lid shall be installed in such a manner as to permit its removal readily from the inlet.

The location of such basement pipe inlets shall be approved by the Building Official and shall be kept readily accessible at all times to the Fire Department.

Approvals

Sec. 3808. All fire extinguishing systems, including automatic sprinklers, wet and dry standpipes, automatic chemical extinguishers, basement pipe inlets and the appurtenances thereto shall meet the approval of the chief of the Fire Department as to installation and location and shall be subject to such periodic tests as he may require.

CHAPTER 39—STAGES AND PLATFORMS

Stage Ventilators

Sec. 3901. There shall be one or more ventilators constructed of metal or other incombustible material near the center and above the highest part of any working stage raised above the stage roof and having a total ventilation area equal to at least five per cent of the floor area within the stage walls. The entire equipment shall conform to the following requirements or their equivalent:

1. Doors shall open by force of gravity sufficient to overcome the effects of neglect, rust, dirt, frost, snow or expansion by heat or warping of the framework.

2. Glass, if used in ventilators, must be protected against falling on the stage. A wire screen, if used under the glass, must be so placed that if clogged it cannot reduce the required ventilating area or interfere with the operating mechanism or obstruct the distribution of water from the automatic sprinklers.

3. The doors and other covers shall be arranged to open instantly after the outbreak of fire, by the use of approved automatic fusible links which will fuse and separate at not more than 160 degrees Fahrenheit. A manual control must also be provided by a cord running down to the stage at a point on each side of the stage designated by the Building Official.

4. The fusible link and the cord must hold the doors closed against a force of at least 30 pounds excess counter weight tending to open the door. The fusible links shall be placed in the ventilator above the roof line and in at least two other points in each controlling cord and so located as not to be affected by the sprinkler heads above. Each stage ventilator shall be operated to an open and closed position at least once before each perfomance.

Gridirons

Sec. 3902. Gridirons, fly galleries and pin-rails shall be constructed of incombustible materials and fire-protection of steel and iron may be omitted. Gridirons and fly galleries shall be designed to support not less than 75 pounds live load per square foot.

The main counter-weight sheave beam shall be designed to support a horizontal and vertical uniformly distributed live load equal to not less than five pounds per square foot over the area of the gridiron directly back of the proscenium opening.

Rooms Accessory to Stage

Sec. 3903. In buildings having a stage, the dressing room sections, workshops, and storerooms shall be located on the stage side of the proscenium wall and shall be separated from each other and from the stage by not less than a "Two-Hour Fire-Resistive Occupancy Separation."

Proscenium Walls

Sec. 3904. A stage as defined in Section 401 shall be completely separated from the auditorium by a proscenium wall of not less than two-hour incombustible construction. The proscenium wall shall extend not less than four feet (4') above the roof over the auditorium.

Proscenium Walls (Cont'd.)

Proscenium walls may have, in addition to the main proscenium opening, one opening at the orchestra pit level and not more than two openings at the stage floor level, each of which shall be not more than twenty-five square feet (25 sq. ft.) in area.

Openings in the proscenium wall of a stage shall be protected by single Class "A" fire doors. The proscenium opening, which shall be the main opening for viewing performances, shall be provided with a self-closing fire-resistive curtain as provided in Chapter 41.

Stage Floors

Sec. 3905. All parts of stage floors shall be of Type I construction except the part of the stage extending back from and the full width of the proscenium opening, which may be constructed of steel or heavy timbers covered with a wood floor not less than two inches (2") nominal thickness. No part of the combustible construction except the floor finish shall be carried through the proscenium opening. All parts of the stage floor shall be designed to support not less than 125 pounds per square foot.

Openings through stage floors shall be equipped with tight-fitting trap doors of wood not less than two inches (2") nominal thickness.

Platforms

Sec. 3906. (a) **Ventilators.** There shall be one or more ventilators, conforming to the requirements of Section 3901, except that the total area shall be equal to 2½ per cent of the area of the platform, located near the center and above the highest part of every enclosed platform having a floor area of five hundred square feet (500 sq. ft.) or more.

(b) **Construction.** Walls and ceiling of an enclosed platform in an assembly room shall be of not less than one-hour fire-resistive construction.

Any usable space having headroom of four feet (4') or more under a raised platform of an assembly room shall be of not less than one-hour fire-resistive construction.

(c) **Accessory Rooms.** In buildings having an enclosed platform, the dressing-room section, workshops, and storerooms shall be separated from each other and from the rest of the building by not less than a "One-Hour Fire-Resistive Occupancy Separation," except that a chair-storage area having headroom of not more than four feet (4') need not be so separated.

Stage Exits

Sec. 3907. At least one exit two feet six inches (2'6") wide shall be provided from each side of the stage opening directly or by means of a passageway not less than three feet (3') in width to a street or exit court. An exit stair not less than two feet six inches (2'6") wide shall be provided for egress from each fly gallery. Each tier of dressing rooms shall be provided with at least two means of egress each not less than two feet six inches (2'6") wide and all such stairs shall be constructed as specified in Chapter 33. The stairs required in this Subsection need not be enclosed.

Miscellaneous

Sec. 3908. A protecting hood shall be provided over the full length of the stage switchboard.

Flame-Retarding *Requirements*

Sec. 3909. No combustible scenery, drops, props, decorations, or other combustible effects shall be placed on any stage or enclosed platform unless it is treated with an effective fire-retardant solution and maintained in a nonflammable condition as approved by the Fire Department.

CHAPTER 40—MOTION PICTURE PROJECTION ROOMS

General

Sec. 4001. (a) **Scope.** The provisions of this Chapter shall apply only where nitrocellulose film is used.

(b) **Projection Room Required.** Every motion picture machine using nitrocellulose films, together with all electrical devices, rheostats, machines and all such films present in any Group A, B, or C occupancy, shall be enclosed in a projection room large enough to permit the operator to walk freely on either side and back of the machine.

Construction

Sec. 4002. Every projection room shall be of not less than one-hour fire-resistive construction throughout and the walls and ceiling shall be finished with incombustible material.

The ceiling shall be not less than eight feet (8′) from the finished floor. The room shall have a floor area of not less than eighty square feet (80 sq. ft.) and forty square feet (40 sq. ft.) for each additional machine.

Exits

Sec. 4003. Every projection room shall have at least two doorways separated by not less than one-third the perimeter of the room, each at least thirty inches (30″) wide and eighty inches (80″) high.

The entrances to the projection room shall be protected by Class "C" fire doors as specified in Section 4306. Such doors shall open outward and lead to proper exits as required in Chapter 33 and shall not be equipped with any latch. The maximum width of such door need be no more than thirty inches (30″).

Ports and Openings

Sec. 4004. (a) **Types.** Ports in projection room walls shall be of three kinds: projection ports; observation ports; and combination ports used for both observation and for stereopticon, spot, or floodlight machines.

(b) **Ports Required.** There shall be provided for each motion picture projector not more than one projection port, which shall be limited in area to one hundred and twenty square inches (120 sq. in.), and not more than one observation port, which shall be limited in area to two hundred square inches (200 sq. in.). There shall be not more than three combination ports, each of which shall not exceed thirty inches (30″) by twenty-four inches (24″). Each port opening shall be completely covered with a single pane of glass not less than one-quarter inch (¼″) in thickness.

(c) **Shutters.** Each port and every other opening in projection room walls, including any fresh-air inlets but excluding exit doors and exhaust ducts, shall be provided with a shutter of not less than No. 10 U. S. gauge sheet metal or its equivalent large enough to overlap at least one inch (1″) on all sides of such opening. Shutters shall be arranged to slide without binding in guides constructed of material equal to the shutters in strength and fire resistance. Each shutter shall be equipped with a 160-degree Fahrenheit fusible link, which when fused by heat will cause closure of the shutter

by gravity. There shall also be a fusible link located over the upper magazine of each projector, which, upon operating, will close all the shutters. In addition, there shall be provided suitable means for manually closing all shutters simultaneously from any projector head and from a point within the projection room near each exit door. Shutters on openings not in use shall be kept closed.

Ventilation

Sec. 4005. (a) Inlet. A fresh-air inlet from the exterior of the building not less than one hundred and forty-four square inches (144 sq. in.) and protected with wire netting shall be installed within two inches (2") of the floor in every projection room, the source of which shall be remote from other outside vents or flues.

(b) **Outlets.** Ventilation shall be provided by one or more mechanical exhaust systems which shall draw air from each arc lamp housing and from one or more points near the ceiling. Systems shall exhaust to outdoors either directly or through a noncombustible flue used for no other purpose. Exhaust capacity shall be not less than fifteen cubic feet (15 cu. ft.) nor more than fifty cubic feet (50 cu. ft) per minute for each arc lamp plus two hundred cubic feet (200 cu. ft.) per minute for the room itself. Systems shall be controlled from within the enclosure and have pilot lights to indicate operation. The exhaust system serving the projection room may be extended to cover rooms associated therewith such as rewind rooms. No dampers shall be installed in such exhaust systems.

Ventilation of these rooms shall not be connected in any way with ventilating or air-conditioning systems serving other portions of the building.

(c) **Exhaust Ducts.** Exhaust ducts shall be of incombustible material, and shall either be kept one inch (1") from combustible material or covered with one-half inch (½") of incombustible heat-insulating material.

Regulation of Equipment

Sec. 4006. (a) **Shelves and Fixtures.** All shelves, fixtures and fixed equipment in a projection room shall be constructed of incombustible materials.

(b) **Films.** All films not in actual use shall be stored in metal cabinets having individual compartments for reels or shall be in I.C.C. shipping containers. Metal used in the construction of cabinets shall be not less than No. 18 U. S. Standard gauge. No solder shall be used in the construction of such metal cabinets.

Sanitary Requirements

Sec. 4007. Every projection room shall be provided with an unenclosed water closet and lavatory.

CHAPTER 41—PROSCENIUM CURTAINS

General Requirements

Sec. 4101. Proscenium curtains when required shall be made of incombustible materials constructed and mounted so as to intercept hot gases, flames and smoke, and to prevent glow from a severe fire on the stage showing on the auditorium side within a period of five minutes. The closing of the curtain from the full open position shall be effected in less than thirty seconds, but the last five feet (5′) of travel shall require not less than five seconds.

Curtain Coverings

Sec. 4102. A proscenium curtain shall be constructed and installed as specified in this Chapter. The curtain shall be made of one thickness of asbestos cloth weighing not less than three and one-quarter pounds per square yard.

The asbestos cloth used in the construction of the curtain shall have incorporated into the yarn before weaving, either monel metal, nickel, brass or other metal or alloy having not less strength than these metals at temperatures up to 1700 degrees Fahrenheit and no less resistance to corrosion at ordinary temperatures. Asbestos cloth made of long fiber blue crocidolite asbestos may be used in place of crysotile asbestos cloth of the same weight. The wires used to reinforce the yarn shall be either single or double but the tensile strength of each wire shall be sufficient to support a load of not less than three pounds at ordinary temperatures, and the strength of two strands of yarn and one wire twisted together shall be sufficient to support a load of six pounds. The strength of the cloth in tension when tested by the strip method shall be not less than 160 pounds per inch of width of warp and 52 pounds per inch of filling.

The asbestos fiber of yarns may contain cotton or other combustible fiber not to exceed 20 per cent of the weight of the asbestos. The total carbon content of the cloth shall not exceed 10 per cent of the total weight of the fiber. When required by the Building Official, a sample of the cloth of sufficient size for testing shall be submitted.

In addition to any decoration, the curtain shall be painted on both sides with a mineral paint having a silicate of soda binder, which will completely fill the cloth. Filler paint shall have not less than four parts of casein in each 10 parts of silicate of soda. This paint shall be well brushed into the cloth so that no light or smoke can come through.

Design and Construction

Sec. 4103. The curtain shall be made of continuous vertical strips of asbestos cloth. The widths of cloth shall overlap at the seams not less than one inch (1″) and shall be sewed with a double row of stitching of asbestos thread.

The curtain shall be wide enough to extend into steel smoke grooves on each side of the proscenium opening at least eight inches (8″) and shall overlap the top and sides of the proscenium opening at least twelve inches (12″).

Six-inch (6″) pockets shall be sewed in the top and the bottom of the curtain to hold the pipe battens; the sides shall be hemmed at least six inches (6″) deep. A two-inch pipe batten shall be placed at the top and a one and one-half inch

Design and Construction (Cont'd.)

(1½") batten at the bottom. For stage openings over forty feet (40') in width the bottom batten shall be not less than two and one-half inches (2½") in diameter. The battens shall be reinforced at the joints with twelve-inch (12") sections of pipe housed and riveted.

The curtain shall be held to the steel guides in the smoke pockets with substantial roller grips riveted or bolted to the side hem, not more than eighteen inches (18") on center. Each roller grip shall be fastened to the curtain with not less than three bolts or rivets.

No. 16 U. S. gauge galvanized metal shall be bent and placed vertically along each side hem of the curtain material, so that both faces of the hem are covered not less than six inches (6"). This metal edging shall be fastened to the side hem with rivets spaced not more than six inches (6") on center.

The top of the curtain shall have a smoke stop fitted to make it as smoke-tight as practicable. The bottom of the curtain shall have a yielding pad of incombustible material not less than three inches (3") thick to form a seal against the floor.

Operating Equipment

Sec. 4104. Smoke grooves which protect the sides of the curtain shall be of structural steel shapes and plates not less than one-quarter inch (¼") thick. These grooves shall be not less than fourteen inches (14") deep and six inches (6") wide and shall be set back from the face of the arch at least six inches (6"). Grooves shall extend from the stage floor to a point three feet (3') above the top of the raised curtain, and shall be securely bolted to the proscenium wall. Details of the grooves shall be submitted to the Building Official and Fire Chief for approval.

Steel tracks shall be built into the smoke grooves upon which shall travel the roller curtain guides and shall be installed rigidly in place and so that roller guides will operate smoothly. Safe support and smooth operation are required with a wind load of one pound per square foot over the entire area of the curtain.

Support for the curtain shall be by means of one-quarter inch (¼") flexible steel cables for curtains forty feet (40') or less in width, and three-eighths-inch (⅜") flexible steel cables for curtains over forty feet (40') in width. These cables shall be spaced not more than twelve feet (12') on centers, and the end overhang shall be not more than fifteen inches (15"). Supporting cables shall be tied to the top batten with a clove-hitch and the end secured with two iron rope clips. A substitute method of attachment will be allowed if approved by the Building Official.

The supporting cables shall pass through sheaves in the gridiron and over to the counterweight guides and shall fasten to the counterweight by means of three-eighths-inch (⅜") turnbuckles with clove-hitches and cable clips. Turnbuckles shall be locked to prevent backing out. Weight of the curtains shall be evenly divided on the cables.

There shall be safety stay chains of straight welded link fastened to the top curtain batten of sufficient strength to support safely the weight of the curtain. There shall be one

Operating Equipment (Cont'd.)

more stay chain than the number of supporting cables and, except for the stay chains at the ends of the curtain, shall be centered between the supporting cables. Stay chains shall be securely attached to the top batten of the curtain and thence to the gridiron, if of steel construction, or shall be bolted through the proscenium wall with three-fourths-inch (¾") bolts. Safety chains shall be so adjusted that they support the curtain when it is lowered and the bottom batten is resting on the pad supported by the floor.

All cables shall be carried over head and loft blocks fitted with ball or roller bearings of ample capacity to accommodate the weight at the speeds required. Grooves in the blocks shall be machined properly to cradle and protect the cable. All blocks supporting the proscenium curtain shall be supported on the proscenium wall by means of steel brackets of suitable size safely to carry the weight, or shall be mounted on structural steel beams.

Blocks shall be installed so that the head-block is sufficiently higher than the loft blocks to prevent cables from fouling loft block housings.

Diameters of the blocks shall be a minimum of twelve inches (12") for three-line sets and sixteen inches (16") for all other sets.

The mechanism and devices for controlling the curtain shall be of simple design and shall be positive in operation. Opening of the curtain shall be by hydraulic or electric power. For curtains where the overbalance on the curtain side does not exceed 150 pounds, manual operation may be used. In this case, manual operation will be allowable only if a method is provided which allows the curtain and counterbalance to be approximately equal under normal conditions, but which adds the required overweight on the curtain side automatically in case of an emergency.

Emergency release shall be by gravity obtained by overbalancing the curtain. The emergency control line shall be of cotton sash cord, fitted with not less than four fusible links, one on each side of the stage and two overhead in the gridiron, which when the links are fused or the sash cord burned will allow the curtain to lower itself automatically. This control line shall extend up both sides of the proscenium arch and across the gridiron, and shall be so arranged that when released it will also automatically open the stage ventilators.

On each side of the proscenium arch, at a location in plain view shall be located an easily read sign, bearing the inscription: "In case of fire, cut line to lower fire curtain," with an indicator pointing to the location of a knife for that purpose. The knives shall be attached to the wall by a chain sufficiently long to reach the release line.

For electric operation there shall be installed push buttons plainly marked: "Fire Curtain—stop: Fire Curtain—down." One set of control buttons shall be installed on each side of the proscenium opening. For hydraulic or manual operation the endless line shall be marked plainly with an arrow pointing the direction for closing.

Operating Equipment (Cont'd.)

For manual operation the operating hand line shall be not less than three-fourths inch (¾") diameter manila rope secured to the top and bottom of the counterweight arbor, and shall pass under a floor block, adjustable for tension, of not less than twelve-inch (12") diameter.

The top and bottom counterweight sections of the arbor shall be of cast iron, sufficiently heavy to accommodate safely the loads. The top and bottom sections shall be connected with rods not less than three-fourths inch (¾") in diameter, with one tie-plate for every four feet (4') of rod. There shall be smooth grooves on the ends of the top and bottom weights which engage the steel guides. Intermediate weights shall be of cast iron, grooved to drop into place on top of the lower carrying weight. The turnbuckles connecting the supporting cables to the top weight shall be attached to eye-bolts passing through the top weight.

Counterweight guide tracks shall be structural "T's" or angles, properly tied together and securely anchored to the proscenium wall. All joints where the counterweight travels shall be ground smooth and a liberal coating of grease shall be applied to the tracks. These guides shall extend from the gridiron a length equivalent to the length of the arbor, plus the travel of the curtain, plus five feet (5'). The specified length shall be considered as the minimum. A structural steel stop shall be provided at the bottom of the arbor.

For proscenium curtains in which the overbalance is in excess of 150 pounds, an approved adjustable checking device shall be installed to check the speed of fall during the last five feet (5') of travel and an alarm shall be installed at the center of the top of the proscenium arch, which will sound when the curtain is descending through the emergency release.

Tests

Sec. 4105. The complete installation of every proscenium curtain shall be subjected to operating tests and any theater in which such proscenium curtain is placed shall not be opened to public performances until after the proscenium curtain has been accepted and approved by the Building Official.

New Designs

Sec. 4106. Curtains of other designs and materials, when not obviously of greater fire resistance than specified in this Chapter, shall before acceptance be subjected to the standard fire test specified in Chapter 43, as applicable to non-bearing partitions, except that such tests shall be continued only for a period of five minutes unless failure shall have occurred previously. The unexposed face of the curtain shall not glow within a period of five minutes nor shall there be any passage of smoke or flame through the curtain.

PART VIII

FIRE-RESISTIVE STANDARDS FOR FIRE PROTECTION

CHAPTER 42 — INTERIOR WALL AND CEILING FINISH

General

Sec. 4201. Interior wall and ceiling finish shall mean interior wainscoting, paneling, or other finish applied structurally or for decoration, acoustical correction, surface insulation or similar purposes. Requirements for finishes shall not apply to trim, doors, windows or their frames, nor to materials which are less than one-twenty-eighth inch (0.036") in thickness cemented to the surface of walls or ceilings, if these materials have flame-spread characteristics no greater than paper of this thickness cemented to an incombustible backing.

Testing and Classification of Materials

Sec. 4202. (a) **Testing.** Flame-spread characteristics of materials used for interior wall or ceiling finish shall be determined by one of the following methods:

1. The "Tunnel Test" as described in U.B.C. Standard No. 42-1.

2. The "Federal Standard Test" as described in U.B.C. Standard No. 42-2.

Combustible materials shall be subjected to a five-minute test in accordance with Test F-3C (2-5) of the above specifications. If the flame does not reach the angle frame at any point during a five-minute test period, the material shall be considered as combustible material.

3. Any other recognized method of test procedure for determining the flame-spread characteristics of finish materials that will give comparable results.

(b) **Application of Terms.** The terms "Fire-Retardant," "Slow-Burning," and "Combustible" as used herein apply only to finish materials as specified in this Chapter.

(c) **Classification.** Three classes of interior finish materials based upon their flame-spread characteristics under the "Tunnel Test" and the "Federal Standard Test" shall be as set forth in Table No. 42-A.

Application of Controlled Interior Finish

Sec. 4203. Where interior finish materials applied to walls and ceilings are regulated for purposes of limiting flame-spread, the following provisions shall apply:

1. Ceiling and wall finishes shall be cemented or otherwise fastened in place in such a manner that they will not readily become detached when subjected to room temperatures of 400° F. for 30 minutes.

TABLE NO. 42-A—FLAME-SPREAD CLASSIFICATION

MATERIAL QUALIFIED BY:		
CLASS	TUNNEL TEST	FEDERAL STANDARD TEST
I	0- 30	Fire-Retardant
II	31- 75	Slow-Burning
III	76-250	Combustible

TABLE NO. 42-B—MINIMUM INTERIOR FINISH CLASSIFICATIONS

OCCUPANCY GROUP	ENCLOSED VERTICAL EXITWAYS	OTHER EXITWAYS	ROOMS OR AREAS
A	I	II	III
B	I	II	III
C	I	II	III
D	I	II	II
E	I	II	III*
F	I	II	III
G	I	II	III
H	I	II	III*
I	NO RESTRICTIONS		
J	NO RESTRICTIONS		

*Over two stories shall be of Class II.

2. Any finish material applied to walls or ceilings, which are required to be incombustible or fire resistive by any provision of this Code, shall be applied directly against such incombustible or fire-resistive surfaces, or to furring strips not exceeding one and three-quarters inches (1¾") applied directly to such incombustible or fire-resistive surfaces where the intervening spaces are filled with an incombustible material or are fire-stopped not to exceed eight feet (8') in any direction.

3. Where walls and ceilings are required to be incombustible or fire-resistive and walls are set out or ceilings are dropped distances greater than as specified in paragraph 2 of this section, incombustible materials shall be used except where the finish materials are either protected on both sides by automatic sprinklers or are attached to an incombustible backing or to furring strips installed as specified in paragraph 2 of this section, applied directly to an incombustible backing so provided and installed as to control fire draft in any concealed spaces.

4. Wall and ceiling finish materials of all classes as permitted in this Chapter may be installed directly against the wood decking or planking of Heavy-Timber Construction or to wood furring strips applied directly to the wood

decking or planking installed and firestopped as specified in paragraph 2 of this section.

5. All interior wall or ceiling finish other than Class I material which is less than one-quarter of an inch (¼") in thickness shall be applied directly against an incombustible backing unless the qualifying tests were made with the material suspended from the incombustible backing.

Finishes Based on Occupancy

Sec. 4204. The minimum flame-spread classification of interior finish as determined by tests, shall be based on use or occupancy as set forth in Table No. 42-B.

EXCEPTIONS: 1. Except in Group D occupancy and in enclosed vertical exitways, Class III may be used in other exitways and rooms with wainscoting extending not more than forty-eight inches (48") above the floor and for tack and bulletin boards covering not more than five per cent of the wall area.

2. Where approved full fire-extinguishing system protection is provided, the flame-spread classification rating may be reduced one classification, but in no case shall materials having a classification greater than Class III be used.

3. The exposed faces of Type III, H.T., structural members and Type III, H.T., decking and planking where otherwise permissible under this Code are excluded from flame-spread requirements.

CHAPTER 43—FIRE-RESISTIVE STANDARDS

General

Sec. 4301. In addition to all the other requirements of this Code, fire-resistive materials shall meet the requirements for fire-resistive construction given in this Chapter.

Fire-Resistive Materials

Sec. 4302. (a) General. Materials used for fire-resistive purposes shall be limited to those specified in this Chapter unless accepted under the procedure given in Section 4302 (b).

(b) **Tests.** For the purpose of determining the degree of fire resistance afforded, the materials of construction listed in this Chapter shall be assumed to have the fire-resistance ratings indicated. Any material or assembly of materials of construction tested in accordance with the requirements of U.B.C. Standard No. 43-1 shall be rated for fire resistance in accordance with the results of such tests, provided that it also meets the performance standards as specified in Section 105.

(c) **Lath.** Gypsum lath shall be not less than three-eighths inch (⅜") in thickness and shall be perforated with holes not less than three-fourths inch (¾") in diameter, except where plain gypsum lath is called for. Perforated gypsum lath shall have one hole for not more than each sixteen square inches (16 sq. in.) of lath surface. Application shall be as specified in Section 4703.

(d) **Plaster.** Plaster shall be gypsum or portland cement plaster not less than one-half inch (½") thick and shall conform to Chapter 47.

(e) **Concrete.** Grade A Concrete is concrete in which at least 60 per cent of the coarse aggregate consists of pumice, limestone, calcareous gravel, trap rock, blast furnace slag, or burned clay or shale.

Grade B Concrete is concrete in which at least 60 per cent of the coarse aggregate consists of granite, sandstone, cinders or a mixture of any of these aggregates with aggregates for Grade A Concrete.

Grade C Concrete is any concrete not classed as Grade A or B.

Where the classification is in doubt, concrete shall be assumed to be Grade C unless tests on the aggregates by an approved agency prove otherwise.

(f) **Pneumatically Placed Concrete.** Pneumatically placed concrete without coarse aggregate shall be classified as Grade A, B or C Concrete in accordance with the aggregate used.

Protection of Structural Members

Sec. 4303. (a) **Protective Coverings. 1. Thickness of Protection.** The thickness of fire-resistive materials for protection of structural members shall be not less than that set forth in Table No. 43-A, except as modified in this Section. The figures shown shall be the net thickness of the protecting materials and shall not include any hollow space back of the protection.

2. Unit Masonry Protection. Unit masonry protection for metal columns shall have metal ties embedded in each transverse joint, where joints are more than sixteen inches

(16") apart, and shall be spaced not more than sixteen inches (16") in other cases. Soffit tile protecting beam and girder flanges shall be tied to the flange. Ties shall have a cross-sectional area equal to that of No. 8 gauge wire. **Protection of Structural Members (Cont'd.)**

3. **Reinforcement for Cast-In-Place Protection.** Cast-in-place protection for metal structural members shall be reinforced at the edges of such members with wire or mesh with a maximum spacing of six inches (6") wound around or attached to the member. The sum of the cross-sectional area in each direction shall be not less than 0.025 square inches per foot.

4. **Embedment of Pipes.** Conduits and pipes shall not be embedded in required fire protection of structural members.

5. **Column Jacketing.** Where the fire-resistive covering on columns is exposed to injury from moving vehicles, the handling of merchandise, or by other means, it shall be jacketed to a minimum height of six feet (6') from the floor with an adequate protective covering.

6. **Ceiling Protection.** Where a ceiling is used to fire protect floors or roofs of incombustible constructions, the constructions and their supporting structural members (beams and girders) need not be individually fire protected except where such members support loads from more than one floor or roof. Ceilings shall be continuous, but may have openings for incombustible pipes, ducts, and electrical outlets, provided the areas of such duct and outlet openings through the ceiling aggregate not more than one hundred square inches (100 sq. in.) in each one hundred square feet (100 sq. ft.) of ceiling area. All duct openings in such ceiling shall be protected by approved fire dampers.

(b) **Protected Members.** 1. **Attached Metal Members.** The edges of lugs, brackets, rivets, and bolt heads attached to structural members may extend to within one inch (1") of the surface of the fire-protection.

2. **Reinforcing.** Thickness of protection for concrete or masonry reinforcement shall be measured to the outside of the reinforcement, except that stirrups and ties may project not more than one-half inch (½") into the protection.

3. **Steel Studs and Joists.** Steel studs and joists are not required to have individual protection when part of an assembly which has a fire-resistive rating.

(c) **Fire Protection Omitted.** Fire protection may be omitted from the bottom flange of lintels, shelf angles or plates that are not a part of the structural frame.

Sec. 4304. (a) **General.** Fire-resistive walls and partitions shall have the ratings set forth in Table No. 43-B. **Walls and Partitions**

(b) **Combustible Members.** Combustible members framed into a wall shall be protected at their ends by not less than one-half the required fire-resistive thickness of such wall.

Sec. 4305. (a) **General.** Fire-resistive floors or ceilings shall have the ratings set forth in Table No. 43-C. **Floors and Ceilings**

(b) **Ceilings.** Where a ceiling of lath and plaster as approved for one-hour fire-resistive construction as specified in this Chapter is used below slabs or structural members not otherwise required to be protected by such a ceiling, the

TABLE NO. 43-A—MINIMUM PROTECTION OF STRUCTURAL PARTS BASED ON TIME PERIODS FOR VARIOUS INCOMBUSTIBLE INSULATING MATERIALS

STRUCTURAL PARTS TO BE PROTECTED	INSULATING MATERIAL USED	MINIMUM THICKNESS OF MATERIAL IN INCHES FOR THE FOLLOWING FIRE-RESISTIVE PERIODS			
		4 hr.	3 hr.	2 hr.	1 hr.
Steel or Cast Iron Columns; Projecting Steel Beam or Girder Flanges; All Members of Primary Trusses	Grade A concrete	2	2	1½	1
	Grade B concrete	2½	2	1½	1½
	Grade C concrete	3	2½	2	1½
	Brick of clay, shale, concrete or sand-lime	3¾	3¾	2¼	1¼
	Clay tile, clay tile and concrete or concrete block (see note 2)	4 or 2 pl.	4 or 2 pl.	2	2
	Solid gypsum blocks	2 pl.	2 pl.	2	2
	Hollow gypsum blocks	3 pl.	3	2	2
	Poured gypsum	2	1½	1	1
	Metal lath and portland cement plaster	.....	.....	2¾*	1
	Metal lath and gypsum plaster	.....	.....	2¼*	¾
	Two ½" layers plain long-length gypsum lath*** wrapped with wire netting. Thickness gypsum-vermiculite plaster	1½	1	.....	.....
	One ⅜" perforated gypsum lath*** no netting. Thickness gypsum-vermiculite plaster	.....	.....	1	.....
	Metal lath and gypsum-vermiculite plaster	1½** 1†	1** ¾	..... ¾	..... ¾

Notes: (1) pl. in Table 43-A shall not be less than ½ in. gypsum or cement plaster.
(2) Reentrant parts of protected members shall be filled solid for 4 and 3 hour protections.
* Two layers with ¾ in. air space between.
** Thickness required for column protection. Lath spaced 1¼" from column. Space behind lath on flange faces filled with plaster.
† ⅝" of vermiculite-gypsum plaster plus ½" of vermiculite acoustical plaster may be used.
‡ Thickness includes gypsum or cement plaster.
*** Lath applied tight against column flanges.

TABLE NO. 43-A (Continued)

Webs of Steel Beams and Girders	Grade A concrete	2	1½	1	1
	Grade B concrete	2½	2	1½	1
	Grade C concrete	3	2½	1½	1
	Brick of clay, shale, concrete or sand-lime	3¾	2¼	2¼	2¼
	Clay tile, clay tile and concrete or concrete block	3 or 2 pl.	2	2	2
	Solid gypsum block	2 pl.	2	2	2
	Hollow gypsum block	3 pl.	2	2	2
	Poured gypsum	2	1½	1	1
	Metal lath and gypsum-vermiculite plaster	1†	¾	¾	¾
	Metal lath and gypsum or portland cement plaster	.....	.....	2	¾
Reinforcing Steel in Reinforced Concrete Columns, Beams, Girders and Trusses	Grade A or B concrete	1½	1½	1½	1
	Grade C concrete	2	1½	1½	1
Reinforcing Steel in Reinforced Concrete Joists	Grade A or B concrete	1¼	1¼	1	¾
	Grade C concrete	1¾	1½	1	¾
Ceiling Protection for Steel Roof Members Including Steel Roof Trusses and Secondary Trusses	Metal or wire lath and gypsum or cement plaster, concrete, burned clay products or gypsum	2	1½	1	¾
	Suspended metal lath and gypsum-vermiculite plaster	1†	¾	¾	¾
Reinforcing and Tie Rods in Floor and Roof Slabs	Grade A or B concrete‡	1	1	¾	¾
	Grade C concrete‡	1¼	1	1	¾
	Gypsum‡	1	1	¾	¾

Notes: (1) pl. in Table 43-A shall not be less than ⅛ in. gypsum or cement plaster.
(2) Reentrant parts of protected members shall be filled solid for 4 and 3 hour protections.
* Two layers with ¾ in. air space between.
** Thickness required for column protection. Lath spaced 1¼" from column. Space behind lath on flange faces filled with plaster.
† ⅝" of vermiculite-gypsum plaster plus ⅛" of vermiculite acoustical plaster may be used.
‡ Thickness includes gypsum or cement plaster.
*** Lath applied tight against column flanges.

TABLE NO. 43-B—RATED FIRE-RESISTIVE PERIODS FOR VARIOUS WALLS AND PARTITIONS

(See Also Pages 245 and 246)

MATERIAL	CONSTRUCTION	Minimum Finished Thickness face to face (including plaster where mentioned) in inches			
		4-hr.	3-hr.	2-hr.	1-hr.
Brick of Clay, Shale, Sand-Lime or Concrete, and Plain Concrete	Solid unplastered	8			4*
	Solid plastered	9		5*	
	Hollow (rowlock) unplastered	12	10	8	
	Hollow (rowlock) plastered	9			
Hollow Clay Tile, Wall	End or side construction. One cell in wall thickness. Plastered				3*
	End or side construction. Two cells in 8-in. or less thickness. Unplastered	16	12		6* or 8
	End or side construction. Two cells in 8-in. or less thickness. Plastered	13	9	7*	
Hollow Clay Tile, Load Bearing (U. B. C. Standard 24-7)	End or side construction. Two cells in wall thickness. Unplastered			6	
	End or side construction. Two cells in wall thickness. Plastered			5*	
	End or side construction. Three cells in 8-in. or less thickness. Unplastered	12			
	End or side construction. Three cells in 8-in. or less thickness. Plastered one side		8½		
	End or side construction. Three cells in 8-in. or less thickness. Plastered	9			
Combination of Brick and Lead-Bearing Tile, (U. B. C. Standard 24-7) or Hollow Concrete Block or Tile	4-in. brick and 4-in. tile. Plastered one side (tile side)	9			

*Shall be used for non-bearing purposes only.

**8 in. for Expanded Slag.

***Mineral or slag wool bats shall weigh not less than 1.0 lb. and glass wool bats not less than 0.6 per sq. ft. of wall surface.

†⅞ in. Face Shells.

††One part gypsum to one part sand by weight for scratch coat and one part gypsum to two parts sand by weight for brown coat.

TABLE NO. 43-B (Continued)

MATERIAL	CONSTRUCTION			Minimum Finished Thickness face to face (including plaster where mentioned) in inches			
				4-hr.	3-hr.	2-hr.	1-hr.
Concrete Block or Tile	Aggregate—Expanded Slag, Burned Clay or Shale, Cinders	1¼-in. face Shells	Unplastered			8	4‡
			Plastered one side		8½	4½‡	
		1½-in. face Shells	Unplastered	12**	8		
			Plastered each side	9			
		2¼-in. face Shells	Unplastered	8			
	Other Aggregates—	1⅝-in. face Shells	Unplastered			8	4‡
			Plastered each side		9	5‡	
		1¾-in. face Shells	Unplastered	12	8		
			Plastered each side	9			
		2¼-in. face Shells	Unplastered	8			
Solid Concrete	Reinforcement not less than 0.2% in each direction			6	5	4	2*
Hollow Gypsum Blocks	Unplastered			6*	5*	4*	3*
	Plastered each side			5*	4*	4*	3*
Hollow Wall of Reinforced Pneumatically Placed Concrete	Outer shell 2-in thick for 10-in. wall and 1½-in. thick for 8-in. wall			10*	8*		
Solid Gypsum or Portland Cement Plaster	Incombustible studding with metal or wire lath						2*
	Incombustible studding with metal or wire lath, neat wood fiber gypsum plaster					2*	
	Studless partition, incombustible runners, ⅜-in. or ½-in. plain gypsum lath, gypsum plaster—each side						2*
	Incombustible studding with metal or wire lath. gypsum-vermiculite plaster					2½*	2*
	Studless partition, incombustible runners, ½-in. plain gypsum-lath gypsum-vermiculite plaster each side					2½*	2*

See Notes Pages 244

TABLE NO. 43-B (Continued)

MATERIAL	CONSTRUCTION	Minimum Finished Thickness face to face (including plaster where mentioned) in inches			
		4-hr.	3-hr.	2-hr.	1-hr.
Hollow Stud Partition with Gypsum or Portland Cement Plaster on each Side or Gypsum Wallboard	Incombustible studding with metal or wire lath, ¾-in. plaster on each side				3
	Incombustible studding with metal or wire lath, 1-in. plaster on each side			4½	
	Wood studs with metal or wire lath. Fire-stopped. ¾-in. plaster on each side				3* or 5*
	Wood studs with metal or wire lath. Fire-stopped. 1-in. neat wood fiber plaster each side			5*	
	Wood studs with ⅜-in. perforated gypsum lath. Fire-stopped. ½-in. gypsum plaster each side				3* or 5*
	Wood studs with space between filled with mineral wood bats *** nailed to studs, one-half inch (½") gypsum wallboard each side				4½
	Wood studs with two layers of one-half inch (½") gypsum wallboard each side, joints staggered				5½
Wood Stud Wall	Exterior—Drop siding over ½-in. gypsum sheathing. Interior—½-in. gypsum plaster over ⅜-in. perforated gypsum lath				5⅝
	Exterior—Drop siding over ½-in. gypsum sheathing. Interior—two thicknesses of ½-in. gypsum wallboard				5¾
Glazed or Unglazed Facing Tile (Non-Bearing)	Cored not in excess of 25%, 2 units in wall thickness with mortar filled collar joint		6*		
	Two inches cored not in excess of 25% and 4 inches structural tile, cored not in excess of 40%, collar joint mortar filled, plastered on one side with ¾ inch gypsum-sand plaster		6*		
	Cored not in excess of 25%, plastered with ¾ inch of gypsum-sand plaster			4*	
	Cored not in excess of 30%, plastered with ¾ inch vermiculite plaster			4*	
	Meeting requirements of U.B.C. Standard No. 43-5, except that shells of solid shell horizontal cell units shall be not less than ¾ inch thick, plastered with ¾ inch gypsum-sand and plaster—(1:3 by volume).				4*

required thickness of slab and fire-protection of structural members may be reduced one-half inch (½") but in no case shall the slab thickness be less than two inches (2").

(c) **Unusable Space Above or Below.** In one-hour fire-resistive construction the ceiling may be omitted over unusable space and flooring may be omitted where unusable space occurs above.

Fire-Resistive Assemblies for Protection of Openings

Sec. 4306. (a) **Where Required.** Class "A" fire doors shall be installed when required in Sections 501, 503 (c) and 3904.

Class "B" fire doors shall be installed when required in Sections 503 (c), 1807, 3305 (e), 3308 (c), and 3309 (d).

Class "C" fire doors shall be installed when required in Sections 503 (c), 1308, and 4003.

Class "D," "E," and "F" fire doors shall be installed when required in Sections 501, 504, 608, 708, 808, 1008, 1102, 1602 (c), 1603 (c), 1807, 1813, 1815, 1913, 3305 (h), 3308 (c), 3311 (d), and 3316.

Fire doors and windows are not required in fire-resistive walls or partitions unless specified elsewhere in this Code.

(b) **Scope.** Fire doors and windows wherever specified in this Code shall meet the requirements of this Section.

(c) **Classification of Openings.** Openings requiring fire doors or windows shall be classified as follows:

"Class 'A' Openings" are openings in "Three-Hour Fire-Resistive Occupancy Separations."

"Class 'B' openings" are openings in "One-Hour Fire-Resistive Occupancy Separations" and in enclosures to vertical shafts.

"Class 'C' openings" are in corridor or room partitions.

"Class 'D,' 'E,' and 'F" openings" are in exterior walls which have severe, moderate, or light fire exposure, respectively.

(d) **Class "A" Openings.** Class "A" openings shall be protected by two automatic Class "A" fire doors, one on each side of the opening and interconnected.

Each Class "A" fire door shall have a fire resistance time period of three hours and shall be without glazed openings.

(e) **Class "B" Openings.** Class "B" openings shall be protected by one automatic or self-closing Class "B" fire door.

A Class "B" fire door shall have a fire resistance time period of one and one-half hours.

Glass panels in a Class "B" fire door shall be limited to one observation panel not exceeding twelve inches (12") in width or height and one hundred square inches (100 sq. in) in area. Where doors are hung on each jamb of a Class "B" opening, an observation panel may be installed in each of the two doors.

(f) **Class "C" Openings.** Class "C" openings shall be protected by one self-closing Class "C" fire door.

A Class "C" fire door shall have a fire resistance time period of one hour, except that doors with glass panels larger than one hundred square inches (100 sq. in.) may have a fire resistance time period of 45 minutes.

Individual glass lights in glazed openings shall be limited in area to twelve hundred and ninety-six square inches (1296 sq. in.).

TABLE NO. 43-C—MINIMUM PROTECTION FOR FLOOR AND ROOF SYSTEMS

MATERIAL	CONSTRUCTION	MINIMUM THICKNESS OF FLOOR OR ROOF SLAB IN INCHES				MINIMUM THICKNESS OF CEILING IN INCHES			
		4 hr.	3 hr.	2 hr.	1 hr.	4 hr.	3 hr.	2 hr.	1 hr.
Solid masonry, concrete or gypsum	Slab or arch (no ceiling required)	4	3	2½	2½				
Hollow masonry	Slab or arch	4*	3½*	3*	3				
Reinforced concrete joists	Slab Suspended ceiling on metal or wire lath gypsum or portland cement plaster **			2½	2			¾	½
	Slab (no ceiling required)				3				
Steel joist or light steel construction, with attached or suspended ceiling of metal or wire lath	Concrete or gypsum slab Ceiling, gypsum plaster	2½	2½	2¼	2	2	1‡	¾	¾
	Concrete or gypsum slab Ceiling, gypsum vermiculite plaster	2½	2½	2	2	1***	¾	¾	¾
	Concrete or gypsum slab Ceiling, portland cement plaster **				2				¾
	T. & G. wood flooring on wood stripping Ceiling, gypsum plaster				1 nom				¾

TABLE NO. 43-C (Continued)

Steel roof deck on steel framing with suspended ceiling of metal or wire lath	Fiberboard insulation or wood fiber and cement binder on top of deck	1½	1	
	Ceiling, gypsum plaster sanded 1 :2			⅞ ¾
	Wood sheathing or fiberboard insulation on top of deck		1	
	Ceiling, gypsum or portland cement plaster **			¾
Steel or precast concrete joists with attached or suspended ceiling of metal or wire lath	Double wood floor with building paper between		1½	
	Ceiling, gypsum or portland cement plaster **			¾
Wood joists	Sub-floor of 1" nom. boarding or ⅝" plywood, a layer of building paper and ½" T. & G. flooring		1⅛	
	Attached ceiling of gypsum lath† and gypsum plaster.			⅞
	Attached or suspended ceiling of metal lath and gypsum or portland cement plaster **			¾
	Attached ceiling of metal lath and vermiculite-gypsum plaster			¾
	Attached ceiling of two layers of ½" gypsum wallboard with a separately attached 20 gauge 1" wire mesh between the two layers			1

Notes: *Requires top covering of solid masonry equal to ½ thickness of slab or arch.
**Portland cement plaster with 15 pounds of hydrated lime and 3 pounds of asbestos fiber per bag of portland cement.
†Neat wood fiber gypsum plaster.
***⅝" of vermiculite-gypsum plaster plus ½" of vermiculite acoustical plastic may also be used.

Fire-Resistive Assemblies for Protection of Openings (Cont'd.)

(g) **Class "D" Openings.** Class "D" openings shall be protected by one automatic closing Class "D" fire door.

Class "D" fire doors shall have a fire resistance time period of one and one-half hours and shall have no glazed openings.

(h) **Class "E" and "F" Openings.** Class "E" and "F" openings shall be protected by a Class "E" or "F" fire door or fire window. Self-closing devices shall not be required.

Class "E" and "F" fire doors and fire windows shall have a time period of fire resistance of 45 minutes.

Individual glass lights shall be limited to fifty-four inches (54") in height, forty-eight inches (48") in width, and seven hundred and twenty square inches (720 sq. in.) in area.

Class "E" and "F" fire windows shall be limited in area to eighty-four square feet (84 sq. ft.) with neither width nor height exceeding twelve feet (12').

Double hung fire windows shall be not more than six feet (6') wide nor more than twelve feet (12') high.

(i) **Glass.** Glass used in fire doors or fire windows shall be not less than one-fourth inch (¼") thick and shall be reinforced with wire mesh, 24 gauge or heavier, with openings not larger than one inch (1") square.

Glass shall be held in place by metal glazing angles, except that in casement windows wire clips may be used.

(j) **Closing Devices.** Automatic fire doors shall be designed to close automatically when the temperature of a heat-actuated device reaches 165 degrees Fahrenheit or 50 degrees above maximum room temperature under normal conditions. Heat-actuated devices shall be installed, one on each side of the wall at the top of the opening and one on each side of the wall at ceiling height where the ceiling is more than three feet (3') above the opening.

Interconnected doors shall be designed so that both doors will close automatically by the action of any of the heat-actuated devices.

Self-closing doors shall be designed to close by gravity or by the action of a mechanical device. Self-closing doors shall have no attachments capable of preventing the operation of the closing devices.

(k) **Fire Resistance Tests.** The fire resistance time rating of every type of required fire protection assembly shall be determined in the manner prescribed by U.B.C. Standard No. 43-2. A minimum transmitted temperature end point shall not be required.

(l) **Label.** Every fire door and fire window shall bear the label or other identification of an approved testing agency showing the classification thereof. The following labels of the Underwriters' Laboratories, Inc., shall be approved labels within the meaning of this Section:

Label marked "Fire Door for Opening in Fire Wall" shall be approved for Class "A" fire doors.

Label marked "Fire Door for Opening in Vertical Shaft" shall be approved for Class "B" fire doors.

Label marked "Fire Door for Opening in Corridor or Room Partition" shall be approved for Class "C" fire doors.

Label marked "Fire Door for Opening in Exterior Wall"

shall be approved for Class "D," "E," and "F" fire doors.

Label marked "Fire Window Frame for Light Exposures" shall be an approved label for fire windows when glazed with wired glass conforming to Subsection (h).

Fire-Resistive Assemblies For Protection of Openings (Cont'd.)

EXCEPTION: Unlabeled passenger elevator hoistway doors may be installed if the panels are of equivalent fire resistance.

(m) **Tin-Clad Doors.** If constructed as specified in U.B.C. Standard No. 43-3, tin-clad fire doors shall be considered as meeting the requirements of this Section, provided each door bears the label of an approved inspection agency showing the classification thereof.

(n) **Installation.** Fire doors and fire windows shall be installed as specified in U.B.C. Standard No. 43-4.

(o) **Signs.** A sign or plaque shall be permanently displayed near or on each required fire door in letters not less than one inch (1") high to read as follows:

FIRE DOOR
DO NOT OBSTRUCT

Sec. 4307. Fire-resistive roof coverings shall be as specified in Section 3204. **Roof Coverings**

PART IX

REGULATIONS FOR USE OF PUBLIC STREETS AND PROJECTIONS OVER PUBLIC PROPERTY

CHAPTER 44—PROTECTION OF PEDESTRIANS DURING CONSTRUCTION OR DEMOLITION

General

Sec. 4401. No person shall place or store any material or equipment necessary for the work under a building permit on a street, alley or public sidewalk, nor shall any work be performed except in accordance with the provisions of this Chapter.

No person shall perform any work on any building or structure, if by so doing he endangers pedestrians on the street that abuts the property line, unless the pedestrians are protected as specified in this Chapter.

Temporary Use of Streets and Alleys

Sec. 4402. Material or equipment necessary for the work under a building permit may be placed or stored on public property in the following locations:

(a) **In Front of the Building Site.** In the one-third portion of the roadway of the street that is adjacent to the curb in front of the building site for which a permit has been issued; provided that no material or equipment shall be placed or stored within five feet (5′) of any rail or any street railway track.

(b) **In Front of the Adjoining Site.** In the roadway of the street adjoining the building site for which a permit has been issued to the same extend and under the same restrictions as specified in Subsection (a) of this Section.

A due waiver of claim against the city for damages on account of such placement or storage must be obtained from the owner of such property and filed in the office of the Building Official before such materials or equipment may be placed or stored.

(c) **In the Alley.** In the alley adjoining the building site for which a permit has been issued, provided that a clear and unobstructed roadway not less than ten feet (10′) in width is maintained through such alley along the building site.

(d) **Public Sidewalk in Front of Building Site.** On any portion of the public sidewalk in front of the building site for which a permit has been issued, except on the walkway required to be maintained.

Restrictions to Storage on Public Property

Sec. 4403. Material and equipment necessary for work to be done under a permit shall not be placed or stored on public property so as to obstruct free and convenient approach to any fire hydrant, fire or police alarm box, any utility box or to any catch-basin or manhole, or so as to interfere with the free flow of water in any street or alley gutter.

Mixing Mortar on Public Property

Sec. 4404. The mixing of mortar or concrete on public property shall be done in a mechanical mixer or in a tight box in such a manner as to prevent dripping or splashing on the public property.

Protection of Utilities

Sec. 4405. A substantial protective frame and boarding shall be built around and over every street lamp, utility box, fire or police alarm box, fire hydrant, and every catch basin and manhole that may be damaged by any work being done under the permit. This protection shall be maintained while such work is being done.

Protection of Pedestrians on Public Property

Sec. 4406. (a) **Walkway.** A walkway not less than four feet (4′) wide with a railing on the street side shall be maintained on the sidewalk in front of the building site during construction, alterations or demolition.

(b) **Type of Protection Required.** Protection shall be provided for pedestrians as set forth in Table No. 44-A, and be constructed as specified in this Chapter.

Such protection shall be maintained in place and kept in good order for the entire length of time pedestrians on the street that abuts the property line may be endangered, and shall be completely removed as soon as such construction work permits.

(c) **Construction of Railings.** Railings shall be substantially built and not less than three feet (3′) high.

(d) **Construction of Fences.** Fences shall be substantially built of tight boards eight feet (8′) high above grade, placed on the side of the walkway nearest to the building site. Fences shall extend the entire length of the building site and each end shall be turned and extended to the building line.

Doorways may be cut in the fence if they are protected by doors and kept closed, except when opened to permit materials or persons to pass through.

TABLE NO. 44-A—TYPE OF PROTECTION REQUIRED FOR PEDESTRIANS

HEIGHT OF CONSTRUCTION	DISTANCE FROM CONSTRUCTION TO WALKWAY	PROTECTION REQUIRED
Eight feet or less	Less than six feet	Railing
	Six feet or more	None
More than eight feet	Less than six feet	Fence and Canopy
	Six feet or more and one-quarter height of construction or less	Fence and Canopy
	Six feet or more and one-fourth to one-half height of construction	Fence
	Six feet or more and at least one-half height of construction	None

Protection of Pedestrians on Public Property (Cont'd.)

(e) **Construction of Canopies.** The protective canopy shall have a clear height of ten feet (10') above the walkway. The roof shall be tightly boarded. Every canopy shall have a tight board fence built along its entire length, on the side thereof next to the building site. The fence shall be solid from the sidewalk or walkway to the canopy roof and each end shall be turned and extended solid to the building site.

The entire structure shall be designed to carry the loads to be imposed on it, provided, the minimum live load to be used in design shall be not less than 35 pounds per square foot, uniformly loaded.

If materials are stored or work is done on the roof of the canopy, the street sides and ends of the canopy roof shall be protected by a tight curb board not less than one foot (1') high and a railing not less than three feet (3') high.

The space under the canopy over the walkway and the approaches thereto shall be kept well lighted with artificial lighting continuously between sunset and sunrise.

Protection of Sidewalk Excavations

Sec. 4407. When the area or a portion thereof occupied by a public sidewalk is to be excavated, the holder of the building permit shall construct a substantial temporary walkway not less than four feet (4') in width for pedestrian travel over the areas to be excavated or around the same.

The walkway over the evacuated area shall be designed for a uniform live load of 150 pounds per square foot. The walkway shall be provided with suitable ramps or stairs at each end and with a handrail not less than three feet (3') high along each side or with a railing on one side and a fence on the other, as the case may require.

The walkway around the excavated area shall be as close to the excavation on the street side as possible and constructed with a railing not less than three feet (3') high and a fence on the excavation side of the walkway.

CHAPTER 45—PERMANENT OCCUPANCY OF PUBLIC PROPERTY

General

Sec. 4501. No part of any structure or any appendage thereto, except signs, shall project beyond the property line of the building site, except as specified in this Chapter.

Structures or appendages regulated by this Code shall be constructed of materials as required in Section 1710 and Chapter 35.

The projection of any structure or appendage shall be the distance measured horizontally from the property line to the outermost point of the projection.

Projection Into Alleys

Sec. 4502. No part of any structure or any appendage thereto, except signs, shall project into any alley except that a curb or buffer block may project not more than nine inches (9″) and not exceed a height of nine inches (9″) above grade.

Space Below Sidewalk

Sec. 4503. The space adjoining a building below a sidewalk on public property may be used and occupied in connection with the building for any purpose not inconsistent with this Code or other laws or ordinances regulating the use and occupancy of such spaces on condition that the right so to use and occupy may be revoked by the city at any time and that the owner of the building will construct the necessary walls and footing to separate such space from the building and pay all costs and expenses attendant therewith.

Balconies and Appendages

Sec. 4504. Oriel windows, balconies, unroofed porches, cornices and belt courses and appendages such as watertables, sills, capitals, bases and other decorative features may project over the public property of the building site a distance as determined by the clearance of the lowest point of the projection above the grade immediately below, as follows:

Clearance above grade less than eight feet (8′)—no projection is permitted.

Clearance above grade over eight feet (8′)—one inch (1″) of projection is permitted for each additional inch of clearance, provided that no such projection shall exceed a distance of four feet (4′).

Marquees

Sec. 4505. (a) **General.** For the purpose of this Section a marquee shall include any object or decoration attached to or a part of said marquee.

(b) **Projection and Clearance.** The horizontal clearance between a marquee and the curb line shall be not less than two feet (2′).

A marquee projecting more than two-thirds of the distance from the property line to the curb line shall be not less than twelve feet (12′) above the ground or pavement below.

A marquee projecting less than two-thirds of the distance from the property line to the curb line shall be not less than eight feet (8′) above the ground or pavement below.

(c) **Length.** A marquee projecting more than two-thirds

Marquees (Cont'd.)

the distance from the property line to the curb line shall not exceed twenty-five feet (25') in length along the direction of the street.

(d) **Thickness.** The maximum height or thickness of a marquee measured vertically from its lowest to its highest point shall not exceed three feet (3') when the marquee projects more than two-thirds of the distance from the property line to the curb line and shall not exceed nine feet (9') when the marquee is less than two-thirds of the distance from the property line to the curb line.

(e) **Construction.** A marquee shall be supported entirely from the building and constructed as specified under Types of Construction and shall be of incombustible material or of not less than one-hour fire-resistive construction.

(f) **Roof Construction.** The roof or any part thereof may be a skylight provided wire glass is used not less than one-fourth inch (¼") thick with no single pane more than eighteen inches (18") wide.

Every roof and skylight of a marquee shall be sloped to downspouts which shall conduct any drainage from the marquee under the sidewalk to the curb.

(g) **Location Prohibited.** Every marquee shall be so located as not to interfere with the operation of any exterior standpipe or to obstruct the clear passage of stairways or exits from the building or the installation or maintenance of electroliers.

Movable Awnings or Hoods

Sec. 4506. Movable awnings or hoods may have combustible coverings supported on incombustible frames attached to the building.

Such awning or hood may extend over the public property not more than two-thirds the distance from the property line to the nearest curb in front of the building site.

The lowest part of any movable awning or hood frame shall be not less than eight feet (8') above the ground immediately below, and the lowest part of any fringe attached to such awning or hood shall be not less than seven feet (7') above the grade immediately below.

Doors

Sec. 4507. Doors in Fire Zones Nos. 1 and 2, either fully opened or when opening, shall not project more than one foot (1') beyond the property line, except that in alleys no projection beyond property line is permitted. Doors in Fire Zone No. 3, that swing over the property line, shall be maintained normally closed.

PART X

PLASTERING

CHAPTER 47—LATHING AND PLASTERING

General

Sec. 4701. Lathing and plastering shall be done in the manner and with the materials specified in this Chapter, and when required for fire protection shall also comply with the provisions of Chapter 43.

No plaster shall be applied until the lathing has been inspected and approved by the Building Official.

The Building Official may require that test holes be made in the wall for the purpose of determining the thickness of the plaster, provided the permit holder has been notified 24 hours in advance of the time of making such test.

Materials

Sec. 4702. (a) **Aggregate.** Sand shall be washed sand conforming to U.B.C. Standard No. 47-1; except that when used with portland cement for scratch coat plastering, the amount of sand retained on a No. 8 sieve shall be not less than 10 per cent or more than 30 per cent.

Vermiculite for base coats shall conform in particle size to the above standard and shall weigh not less than seven and one-half nor more than ten pounds per cubic foot.

(b) **Gypsum Plaster.** Gypsum plaster shall conform to U.B.C. Standard No. 47-2.

(c) **Lime.** Lime shall conform to the requirements of U.B.C. Standard No. 24-12 or U.B.C. Standard No. 24-13.

Lime putty shall be made from quicklime or hydrated lime, and shall be prepared in an approved manner, stored and protected for an approved period of time.

(d) **Keene's Cement.** Keene's cement shall conform to U.B.C. Standard No. 47-3.

(e) **Portland Cement.** Portland cement shall be Type I, II, or III conforming to U.B.C. Standard No. 26-1, except with respect to insoluble residue.

Approved types of plasticity agents may be added to portland cement, Types I or II, in the manufacturing process or when mixing the plaster, but in no case shall the amount of plasticity agent exceed 10 per cent of the volume of cement in the plaster mixture.

(f) **Wood Lath.** Wood lath shall conform to the requirements of U.B.C. Standard No. 47-4.

(g) **Fiber Insulation.** Fiber insulation lath shall be manufactured from wood or other vegetable fiber in accordance with U.B.C. Standard No. 47-5.

(h) **Gypsum Lath.** Gypsum lath shall conform to U.B.C. Standard No. 47-6, and shall be not less than three-eighths inch (⅜") in thickness.

(i) **Metal and Wire Lath.** Metal and wire lath, metal accessories and channels shall conform to the requirements of U.B.C. Standard No. 47-7.

Interior Plastering: Lathing

Sec. 4703. (a) **Distance Between Supports.** For gypsum, wood, and fiber insulation laths, the distance between supports shall not exceed sixteen inches (16").

Internal angles, external angles, coves, arches and junctures between wood, fiber insulation, gypsum lath and other plaster bases shall be reinforced with cornerite, except where metal or wire lath is carried around such intersections. Cornerite shall be fastened only sufficiently to retain position during plastering and shall not be rigidly attached to the wood framing.

No interior lath shall be applied until all exterior framing is covered.

(b) **Gypsum Lath.** Gypsum lath shall be nailed to wood supports at intervals not to exceed five inches (5") with 13-gauge, one and one-eighth inch (1⅛"), nineteen sixty-fourth inch (19/64") diameter flat head, galvanized or blued nails. Lath shall be secured to horizontal or vertical metal supports by means of approved special clips.

Joints between walls and ceilings shall be staggered. Lath shall be applied with joints broken in each course except that end joints may fall on one support when stripped with three inches (3") of metal lath. Lath shall be butted together.

(c) **Wood Lath.** Wood lath shall be spaced not less than one-quarter inch (¼") or more than three-eighths inch (⅜") apart at edges, one-quarter inch (¼") apart at ends, and shall be nailed with 3d fine, 16-gauge, blued nails, full driven. Joints shall be broken every seventh lath and above or below all openings.

Lath shall run approximately at right angles to the supporting members, and no lath shall extend through any wall.

Wood lath shall be thoroughly soaked before being nailed in place, and kept damp until plaster is applied.

(d) **Fiber Insulation Lath.** Fiber insulation lath shall be nailed to wood supports at intervals not to exceed four and one-half inches (4½") with nails of the following sizes, placed not less than three-eighths inch (⅜") from the ends, and not less than one-half inch (½") from shiplapped, tongued and grooved, or interlocking edges:

For one-half inch (½") lath—One and one-eighth inch (1⅛") fiberboard nails or 4d box nails.

For one-inch (1") lath—One and three-fourths inch (1¾") fiberboard nails or 6d box nails.

End joints, except in interlocking type lath, shall be not less than three-sixteenths inch (3/16") wide. Shiplapped, tongued and grooved, or interlocking edges shall be fitted to contact.

(e) **Metal and Wire Lath.** 1. The weight of metal and wire lath and the spacings of supports shall conform to the requirements set forth in Table No. 47-A.

2. Metal and wire lath shall be lapped at least one mesh at side and ends, but need not exceed one inch (1").

Lathing (Cont'd.)

TABLE NO. 47-A—WEIGHTS OF METAL AND WIRE LATH

WEIGHT (Lbs. per sq. yd.)	TYPE OF LATH	MAXIMUM SPACING OF SUPPORTS	
		For Walls	For Ceilings
2.5	Flat Expanded metal lath	16"	0
3.4	Flat Expanded metal lath	16"	16"
2.75	Flat Rib metal lath	16"	16"
3.4	Flat Rib metal lath	24"	24"
3.4	⅜" Rib metal lath*	24"	24"
4.5	Sheet metal lath	24"	24"
2.48	Wire lath	16"	12"
**	Wire fabric	16"	16"

* Rod-stiffened or V-stiffened flat expanded metal lath of equal rigidity and weight is permissible on the same spacings as ⅜-inch rib metal lath.

** Paper-backed wire fabric, No. 16 gauge wire, 2" x 2" mesh, with stiffener.

TABLE NO. 47-B—SIZES OF MAIN RUNNERS IN SUSPENDED AND FURRED CEILINGS

DISTANCE CENTER TO CENTER OF HANGERS	SIZE	MAIN RUNNERS	
		Hot Rolled	Cold Rolled
Up to 2 feet	¾"	300 lb./1000 ft.	300 lb./1000 ft.
Up to 3 feet	1"	410 lb./1000 ft	
Up to 4 feet	1½"	650 lb./1000 ft.	475 lb./1000 ft.

3. Metal and wire lath shall be attached to vertical wood supports at not to exceed six-inch (6") spacing with not less than 4d common nails driven to a penetration of at least three-quarters inch (¾") and bent over to engage not less than three strands of lath. Metal and wire lath shall be attached to ceiling joists or other horizontal wood supports with not less than one and one-half inches (1½"), 11 gauge, barbed nails with a head not less than seven-sixteenths inch (7/16") in diameter, or an equivalent approved attachment.

4. Metal and wire lath shall be attached to horizontal and vertical metal supports at not to exceed six-inch (6") spacing with not less than No. 18 W. and M. gauge, galvanized annealed wire, or an equivalent approved attachment.

Non-Bearing Lath and Plaster Partitions

Sec. 4704. Where reinforced plaster or pneumatically placed plaster partitions are used they shall have vertical steel or iron channels with a depth of not less than one-third the thickness of the partition, made of not less than No. 16 U. S. gauge metal and spaced not more than twenty-four inches (24") on center. They shall be securely fastened and anchored to adjoining framing members.

Hollow non-bearing partitions of reinforced plaster or pneumatically placed plaster shall have a shell thickness of not less than three-fourths inch (¾").

Metal reinforcing shall be as set forth in Table No. 47-A, and gypsum lath shall not be less than three-eighths inch

Non-Bearing Lath and Plaster Partitions (Cont'd.)

TABLE NO. 47-C—SIZES OF CROSS FURRING IN SUSPENDED AND FURRED CEILINGS

DISTANCE CENTER TO CENTER OF MAIN RUNNER	SIZE OF CROSS FURRING	MAXIMUM SPACING
Up to 2 feet	¼" pencil rods	12"
Up to 3 feet	¾" channels	24"
Up to 4 feet	¾" channels	16"

TABLE NO. 47-D—REQUIRED THICKNESS OF INTERIOR PLASTER

TYPE OF LATH	THICKNESS OF PLASTER
Metal or wire lath	⅝" minimum
All other types allowed in Chapter 47	½" minimum

(⅜") in thickness. The minimum thickness of metal lath and plaster, or pneumatically placed plaster partitions shall be not less than two inches (2") nor one eighty-fourth of the distance between supports. Studless solid partitions of metal lath and plaster or gypsum lath and plaster shall be not more than twelve feet (12') in height.

Interior Plastering: Suspended and Furred Ceilings

Sec. 4705. (a) General. Suspended or furred ceilings shall be designed to meet the requirements of this Section, or shall be designed for a live load of 10 pounds per square foot.

(b) **Main Runners.** Main runners shall be hot rolled or cold rolled steel channels, and shall be not less than the sizes and weights set forth in Table No. 47-B.

(c) **Cross Furring.** Cross furring for various spacings of main runners or other supports shall be not less than as set forth in Table No. 47-C.

Cross furring shall be securely attached to the main runners or other supports by not less than two strands of No. 16 W. and M. gauge galvanized wire or equivalent approved attachments.

(d) **Hangers.** Hangers for suspended ceilings shall be not less than No. 8 W. and M. gauge galvanized wire, fastened to or embedded in the structural framing, masonry or concrete. Not less than two strands of No. 14 W. and M. gauge galvanized wire or equivalent approved attachments shall be used to attach carrying members to joists or beams.

Hangers shall be saddle tied or wrapped around main runners so as to develop the full strength of the hangers. Lower ends of flat hangers shall be bolted with three-eighths inch (⅜") bolts to runner channels, or bent tightly around runners and bolted to the main part of the hanger.

Interior Plastering: Number of Coats and Thickness

Sec. 4706. (a) Number of Coats. Pastering with gypsum, hardwall, lime or cement plaster shall be three-coat work when applied over metal and wire lath, and shall be not less than two-coat work when applied over other plaster bases allowed in this Chapter.

Lime or cement plaster shall not be applied directly to fiber insulation lath or gypsum lath.

In no case shall a brush coat be accepted as a required coat where three-coat work is required by this Section.

Interior Plastering: Number of Coats and Thickness (Cont'd.)

(b) **Thickness.** Grounds shall be installed to provide for the thicknesses of plaster, from face of plaster base to finished plaster surfaces, set forth in Table No. 47-D.

If monolithic concrete ceiling surfaces require more than three-eighths inch (⅜") of plaster to produce desired lines or surfaces, metal lath or wire lath shall be attached thereto.

Sec. 4707. (a) **Base Coats.** The base coats shall be mixed and proportioned in accordance with the following procedure:

Interior Plastering: Proportioning and Mixing

1. **Gypsum or Hardwall Plaster.** First coat on all types of lath shall be mixed in the proportion of one part of gypsum or hardwall plaster to not more than two parts of sand, by weight.

First coat on masonry surfaces (except monolithic concrete) and second coat (brown) in all three-coat work shall be mixed in the proportions of one part of gypsum or hardwall plaster to not more than three parts of sand, by weight.

When vermiculite is used in place of sand, the first coat on all types of lath shall be mixed in the proportion of 100 pounds of gypsum plaster to not more than two and one-half cubic feet (2½ cu. ft) of vermiculite; the first coat on masonry surfaces (except monolithic concrete) and the second coat in all three-coat work shall be mixed in the proportion of 100 pounds of gypsum plaster to not more than three and one-half cubic feet (3½ cu. ft.) of vermiculite.

2. **Wood Fiber Gypsum Plaster.** Wood fiber gypsum plaster shall be mixed with water only, for use on all types of lath, and shall be mixed in the proportion of one part of plaster to one part of sand by weight for use on masonry.

3. **Lime Plaster.** The first coat for three-coat work on metal and wire lath shall be composed of eleven cubic feet (11 cu. ft.) of lime putty or 500 pounds of hydrated lime, 150 pounds of Keene's cement and six pounds of fiber to one cubic yard (1 cu. yd.) of sand.

The second coat for three-coat work on metal and wire lath and for two-coat work on wood lath, brick, tile, or concrete, shall be composed of ten cubic feet (10 cu. ft.) of lime putty or 450 pounds of hydrated lime, 150 pounds of Keene's cement and four pounds of fiber to one cubic yard (1 cu. yd.) of sand.

4. **Portland Cement Plaster.** For three-coat work, the first two coats shall be as required for the first two coats of exterior work.

(b) **Finish Coats for Gypsum or Lime Plaster.** The finish coats shall be mixed and proportioned in accordance with the following procedure:

1. **Smooth white finish,** mixed in the proportion of not less than one part gypsum gauging plaster or Keene's cement to three parts lime putty by volume, or a prepared gypsum trowel finish.

Interior Plastering: Proportioning and Mixing (Cont'd.)

2. **Sand-float finish,** mixed in the proportion of one part gypsum neat unfibered plaster to not more than two parts sand by weight, or one and one-half parts of Keene's cement to two parts of lime putty and not more than four and one-half parts of sand by volume, or a prepared gypsum sand-float finish.

3. **Keene's cement finish,** mixed in the proportions of three parts Keene's cement to one part lime putty, by volume.

4. **Lime sand-float finish** shall be mixed in the proportion of one part of gypsum gauging plaster or Keene's cement, three parts of lime putty, and three parts of sand by volume.

5. **Interior stucco finish** shall be mixed in the proportion of one part of Keene' cement, two parts of lime putty, and three parts of white sand by volume, or a prepared color finish.

6. **Vermiculite plaster** finish shall be mixed in the proportion of one cubic foot of vermiculite finish aggregate to 100 pounds of unfibered gypsum plaster.

(c) **Finish Coat for Portland Cement Plaster.** Finish coats for interior portland cement plaster may be:

1. As required for the third coat of exterior stucco.

2. A gauged cement plaster mixed in proportion of one part portland cement to not more than two and one-half parts of lime putty and not more than four parts of sand by volume.

3. Smooth white finish, mixed in the proportion of not less than one part gypsum gauging plaster or Keene's cement to three parts lime putty by volume.

4. Keene's cement finish, mixed in the proportions of three parts Keene's cement to one part lime putty, by volume.

5. Lime sand-float finish shall be mixed in the proportion of one part gypsum gauging plaster or Keene's cement, three parts of lime putty, and three parts of sand, by volume.

6. Interior stucco finish shall be mixed in the proportion of one part of Keene's cement, two parts of lime putty, and three parts of white sand by volume, or a prepared color finish.

EXCEPTION: When finishes No. 3, No. 4, No. 5, or No. 6 are used, portland cements having plasticity agents added in the manufacturing process shall not be used in the coat to which this finish is applied.

Interior Plastering: Application of Plaster

Sec. 4708. (a) **Base Coats. 1. Gypsum Plaster.** The scratch coat shall be applied with sufficient material and pressure to form a full key or bond.

For two-coat work it shall be doubled back to bring the plaster out to grounds and straightened to a true surface and left rough to receive the finish coat. For three-coat work, the surface shall be scratched to provide a bond for the brown coat and shall have been in place at least 12 hours before the second or brown coat is applied. The second or brown coat shall be brought out to grounds, and straightened to a true surface and left rough, ready to receive the finish coat.

2. **Lime Plaster.** The first two coats shall be applied in the same manner as gypsum plaster, except that in three-

TABLE NO. 47-E—EXTERIOR PLASTER REINFORCEMENT

TYPE OF REINFORCEMENT	MINIMUM GAUGE	MINIMUM WEIGHT (lbs. per sq. yd.)
Expanded Metal		1.8
Metal Lath		3.4
Welded or Woven Wire Netting	18	1.4
Welded Wire Fabric	16	1.0

Interior Plastering: Application of Plaster (Cont'd.)

coat work, the second coat (brown) shall be applied over a dry base coat.

3. **Portland Cement Plaster.** The first two coats shall be as required for the first two coats of exterior work, except that the interval between the first and second coats shall be not less than 24 hours.

(b) **Finish Coats.** 1. Smooth white finish shall be applied over base coat which has set and is surface-dry. Thickness shall be from one-sixteenth inch (1/16") to one-eighth inch (⅛").

2. Sand-float finish shall be applied over set base coat which is not quite dry.

3. Keene's cement finish shall be applied over set base coat which is not quite dry. Thickness shall be from one-sixteenth inch (1/16") to one-eighth inch (⅛"), unless finish coat is marked off or jointed, in which case the thickness may be increased as required by depth of marking or jointing.

4. The finish coat for interior portland cement plastering shall be applied in the same manner as required for the third coat of exterior stucco, except that other types of finish coat may be applied as specified in Section 4707 (c).

5. Vermiculite finish coat shall be applied over a base coat which is semi-green. Thickness shall be from one-sixteenth inch (1/16") to one-eighth inch (⅛").

(c) **Plaster on Concrete.** Monolithic concrete surfaces shall be clean, free from efflorescence, damp and sufficiently rough to insure adequate bond.

Gypsum plaster applied to monolithic concrete ceilings shall be specially prepared bond plaster for use on concrete, to which water only shall be added. Gypsum plaster on monolithic walls and columns shall be applied over a scratch coat of bond plaster before it has set. The brown coat shall be brought out to grounds, straightened to a true surface and left rough, ready to receive finish coat.

Lime plaster applied to concrete walls shall be as specified in Section 4707.

Portland cement plaster applied to interior concrete walls or ceilings shall conform to requirements for application to exterior concrete walls as specified in Section 4711 (e).

Sec. 4709. Staff. Staff shall be soaked before sticking. Lugs shall be of pure fiber and plaster of paris. Rust-resistive fastenings of sufficient strength to anchor the staff to the support shall be not less than No. 14 B. and S. gauge copper wire.

Interior Plastering: Staff

TABLE NO. 47-F—EXTERIOR PORTLAND CEMENT PLASTER

COAT	MAXIMUM VOLUME OF SAND PER VOLUME OF CEMENT	MINIMUM THICKNESS	MINIMUM PERIOD MOIST CURING	MINIMUM INTERVAL BEFORE APPLICATION OF SUCCEEDING COAT
First or scratch	3½	⅜"*	48 hrs.	48 hrs.
Second or brown	4½	(1st & 2nd coats) ¾"	48 hrs.	7 days
Third or finish	2**	⅛"		

*Measured from backing to crest of scored plaster.
**Approved prepared finish coats containing not less than 1/3 by weight of portland cement may be used.

Exterior Plastering: Backing

Sec. 4710. (a) **Backing.** Studs shall be sheathed, or wire of not less than No. 18 W. and M. gauge shall be stretched taut horizontally at intervals not exceeding six inches (6") on centers vertically and securely fastened in place. This shall not be required with metal lath or paper-backed wire fabric.

(b) **Weather Protection.** Weather protection shall be as specified in Section 2217.

(c) **Metal Reinforcement.** Exterior plaster, except when applied to concrete or masonry, shall be reinforced with one of the materials having a rust-resistive coating as set forth in Table No. 47-E.

Metal reinforcement shall be furred out from the backing at least one-quarter inch (¼") by an approved furring method, and shall be nailed with galvanized nails or approved furring devices driven to at least three-quarters inch (¾") penetration which shall be spaced not more than six inches (6") apart vertically and sixteen inches (16") apart horizontally. Metal reinforcement shall be lapped at least one full mesh at all joints. When no sheathing is used, all vertical joints shall be made at the studs, and horizontal joints where expanded metal or metal lath is used shall have at least one tie between studs, made with No. 18 W. and M. gauge galvanized annealed tie wire.

Exterior Plastering: Application

Sec. 4711. (a) **General.** Exterior cement plaster shall be portland cement plaster meeting the requirements of Table No. 47-F, except when applied over concrete or masonry.

(b) **Plasticity Agents.** Plasticity agents shall be of approved types and amounts, and if added to portland cement in the manufacturing process, no later additions shall be made.

(c) **Application. 1. General.** Except when applied to concrete or masonry, and except as otherwise provided for pneumatically applied plaster, exterior cement plastering materials shall be mixed by machine methods for not less than two minutes, and shall be applied in three coats as set forth in Table No. 47-F.

The first coat shall be forced through all openings in the

reinforcement so as solidly to fill all spaces. It shall then be scored horizontally with a scratcher having one-eighth inch (⅛") clipped teeth and grooves not more than one-half inch (½") deep. **Exterior Plastering: Application (Cont'd.)**

The second coat shall be rodded and water floated, with no variation greater than one-quarter inch (¼") in any direction under a five-foot (5') straightedge.

The third coat shall not be a brush coat.

2. Plastering on Masonry or Concrete. The masonry surface on which plaster is to be applied shall be clean, free of efflorescence, damp and sufficiently rough to insure proper bond. Mixtures specified for the second coat in this Section may be applied directly to masonry.

Sec. 4712. Pneumatically placed cement plaster shall be a mixture of portland cement and sand, mixed dry, conveyed by air through a pipe or flexible tube, hydrated at the nozzle at the end of the conveyor and deposited by air pressure in its final position. **Pneumatically Placed Plaster**

Rebound material may be screened and re-used as sand in an amount not greater than 25 per cent of the total sand in any batch.

Pneumatically placed cement plaster shall consist of a mixture of one part cement to not more than five parts of sand. Plasticity agents may be used as specified in Section 4711 (b). Except when applied to concrete or masonry, such plaster shall be applied in not less than two coats to a minimum total thickness of seven-eighths inch (⅞"). The first coat shall be rodded as specified in Section 4711 (c) for the second coat. The curing period and time interval shall be as set forth in Table No. 47-F.

Sec. 4713. Portland cement plaster not less than one and one-half inch (1½") in thickness reinforced in two directions with not less than three-tenths per cent of steel may be considered to act with the studs to resist bending and shear under horizontal forces when said reinforcement is anchored to the stud in such a manner as to resist effectively the stresses developed. The unit stresses for such reinforced plaster shall not be more than 50 per cent of those allowed for concrete set forth in Table No. 26-B, based on a compressive strength of such plaster of 1500 pounds per square inch. **Portland Cement Plaster**

PART XI

SPECIAL SUBJECTS

CHAPTER 48—FILM STORAGE

Film Storage

Secs. 4801, 4802 and 4803. Where it is desired to regulate film storage, complete provisions covering handling and storage of photographic and X-ray nitrocellulose films may be found in Appendix Chapter 48.

CHAPTER 49—MECHANICAL REFRIGERATION

Refrigeration

Secs. 4901 and 4902. Where it is desired to regulate the type and installation of mechanical refrigeration, complete provisions may be found in the Appendix, Chapter 49.

CHAPTER 50—PREFABRICATED CONSTRUCTION

General

Sec. 5001. (a) Purpose. The purpose of this Chapter is to regulate materials and establish methods of safe construction where any structure or portion thereof is wholly or partially prefabricated.

(b) **Scope.** Unless otherwise specifically stated in this Chapter, all prefabricated construction and all materials used therein shall conform to all the requirements of this Code. (See Section 105.)

(c) **Definition. Prefabricated Assembly** is a structural unit, the integral parts of which have been built up or assembled prior to incorporation in the building.

Tests of Materials

Sec. 5002. Every approval of a material not specifically mentioned in this Code shall incorporate as a proviso the kind and number of tests to be made during prefabrication.

Tests of Assemblies

Sec. 5003. The Building Official may require special tests to be made on assemblies to determine their durability and weather resistance.

Connections

Sec. 5004. (a) **Design.** Every device designed to connect prefabricated assemblies shall be capable of developing the strength of the members connected, except in the case of members forming part of a structural frame designed as specified in Chapter 23. The connection device shall be designed as required by the other chapters in this Code. Connections between roofs and the supporting walls shall be capable of withstanding an uplift equal to five pounds per square foot of roof.

Pipes and Conduits

Sec. 5005. (a) Structural Design. In structural design, due allowance shall be made for any material to be removed for the installation of pipes, conduits, or other equipment.

Certificate and Inspection

Sec. 5006. (a) **Materials.** Materials and the assembly thereof shall be inspected to determine compliance with this Code. Every material shall be grade marked or labeled where required elsewhere in this Code.

(b) **Certificate.** A certificate of approval shall be furnished with every prefabricated assembly, except where the assembly is readily accessible to inspection at the site. The certificate of approval shall certify that the assembly in question has been inspected and meets all the requirements of this Code. When mechanical equipment is installed so that it cannot be inspected at the site, the certificate of approval shall certify that such equipment complies with the laws applying thereto.

(c) **Certifying Agency.** To be acceptable under this Code, every certificate of approval shall be made by an approved agency.

(d) **Field Erection.** Placement of prefabricated assemblies at the building site shall be inspected by the Building Official to determine compliance with this Code.

(e) **Continuous Inspection.** If continuous inspection is required for certain materials where construction takes place on the site, it shall also be required where the same materials are used in prefabricated construction.

EXCEPTION: Continuous inspection will not be required during prefabrication if the approved agency certifies to the construction and furnishes evidence of compliance.

CHAPTER 51—HEAT PRODUCING APPLIANCES

(See Appendix, Page 286).

PART XII

LEGISLATIVE

CHAPTER 60—LEGISLATIVE

Validity

Sec. 6001. If any section, subsection, sentence, clause or phrase of this Ordinance is, for any reason, held to be unconstitutional, such decision shall not affect the validity of the remaining portions of this Ordinance. The City Council hereby declares that it would have passed this Ordinance, and each section, subsection, clause or phrase thereof, irrespective of the fact that any one or more sections, subsections, sentences, clauses and phrases be declared unconstitutional.

Uniform Building Code Standards

Sec. 6002. The U.B.C. Standards which are referred to in various parts of this Ordinance shall be the Uniform Building Code Standards, 1952 Edition, and are hereby declared to be a part of this Ordinance.

U. B. C. STD. NO.	TITLE	EXCERPTS FROM:
	CHAPTER 4	
4-1	Incombustible Material —Tests	P.C.B.O.C. Specification
	CHAPTER 9	
9-1	Flammable Liquids	National Board of Fire Underwriters Pamphlet 30 (April, 1952)
	CHAPTER 10	
10-1	Class III Dry-Cleaning Systems	Standards for Safeguarding Dry Cleaning and Dry Dyeing Plants (Pamphlet 32—February, 1944) of the National Board of Fire Underwriters
10-2	Blower and Exhaust Systems for Dust, Stock and Vapor Removal	National Board of Fire Underwriters Pamphlet 91 (November, 1949)
	CHAPTER 22	
22-1	Structural Insulating Board	Federal Specifications LLL-F-321b-42
22-2	Gypsum Sheathing Board	Standard Specifications C79-50 of the American Society for Testing Materials
	CHAPTER 24	
24-1	Building Brick, (Made from Clay or Shale)	Standard Specifications C62-50 of the American Society for Testing Materials
24-2	Sand-Lime Building Brick	Standard Specifications C73-51 of the American Society for Testing Materials

Uniform Building Code Standards (Cont'd.)

U. B. C. STD. NO.	TITLE	EXCERPTS FROM:
24-3	Concrete Building Brick	Standard Specifications C55-37 of the American Society for Testing Materials
24-4	Hollow Load-Bearing Concrete Masonry Units	Standard Specifications C90-44 of the American Society for Testing Materials
24-5	Solid Load-Bearing Concrete Masonry Units	Standard Specifications C145-40 of the American Society for Testing Materials
24-6	Hollow Non-Load-Bearing Concrete Masonry Units	Standard Specifications C129-39 of the American Society for Testing Materials
24-7	Structural Clay Load-Bearing Wall Tile	Standard Specifications C34-50 of the American Society for Testing Materials
24-8	Structural Clay Non-Load-Bearing Tile	Standard Specifications C56-50 of the American Society for Testing Materials
24-9	Structural Clay Floor Tile	Standard Specifications C57-50 of the American Society for Testing Materials
24-10	Gypsum Partition Tile or Block	Standard Specifications C52-41 of the American Society for Testing Materials
24-11	No Standard	
24-12	Quicklime for Structural Purposes	Standard Specifications C5-26 of the American Society for Testing Materials
24-13	Special Finishing Hydrated Lime	Tentative Specifications C206-49 of the American Society for Testing Materials
24-14	Hydraulic Hydrated Lime for Structural Purposes	Standard Specifications C141-42 of the American Society for Testing Materials
24-15	Natural Cement	Standard Specifications C10-37 of the American Society for Testing Materials
24-16	Cement; Masonry	Federal Specifications SS-C-181 b (January 12, 1938, with Amendments of April 20, 1939) of the United States Federal Government
24-17	Gypsum	Standard Specifications C22-50 of the American Society for Testing Materials
24-18	Aggregate for Masonry Mortar	Standard Specifications C144-44 of the American Society for Testing Materials
24-19	Cast Stone	Specification ACI 704-44 of the American Concrete Institute
24-20	Reinforced Gypsum	American Standard Building Requirements (ASA: A59.1-1945) of the American Standards Association.

Uniform Building Code Standards (Cont'd.)

U. B. C. STD. NO.	TITLE	EXCERPTS FROM:
	CHAPTER 25	
25-1	American Lumber Standards for Softwood Lumber	Simplified Practice Recommendation R16-33 of the U.S. Department of Commerce, Bureau of Standards
25-2	Guide to the Grading of Structural Timbers and the Determination of Working Stresses	Miscellaneous Publication 185 (February, 1934) of the Forest Products Laboratory, U.S. Department of Agriculture
25-2	Recommendations for Basic Stresses	Supplement No. 2 (June, 1948) to U.S. Department of Agriculture Miscellaneous Publication 185
25-3	Douglas Fir Plywood	Commercial Standard CS45-48 of the U.S. Department of Commerce, Bureau of Standards
25-4	Tidewater Red Cypress	Standard Specifications for Grades of Tidewater Red Cypress (July 15, 1950) of the Southern Cypress Manufacturers' Association
25-5	Douglas Fir, Coast Region	Standard Grading and Dressing Rules for West Coast Lumber No. 14 (August 1, 1947, revised November 1, 1948) of the West Coast Bureau of Lumber Grades and Inspection, West Coast Lumbermen's Association
25-6	Eastern Hemlock	Official Grading Rules for Hemlock and Tamarack Lumber (November 15, 1950) of the Northern Hemlock and Hardwood Manufacturers' Association
25-7	West Coast Hemlock	Standard Grading and Dressing Rules for West Coast Lumber No. 14 (August 1, 1947, revised November 1, 1948) of the West Coast Bureau of Lumber Grades and Inspection, West Coast Lumbermen's Association
25-8	Douglas Fir, Inland (Western Pine) Region	Standard Grading Rules (for Douglas Fir) (April 15, 1949) of the Western Pine Association
25-9	Larch	Standard Grading Rules (for Larch) (April 15, 1949) of the Western Pine Association
25-10	Red and White Oak	Standard Specifications for Structural Stress-Grades of Hardwoods and Cypress (1952) of the National Hardwood Lumber Association
25-11	Southern Pine	Standard Grading Rules for Southern Pine Lumber (September 1, 1948) of the Southern Pine Inspection Bureau, Southern Pine Association

Uniform Building Code Standards (Cont'd.)

U. B. C. STD. NO.	TITLE	EXCERPTS FROM:
25-12	Southern Longleaf Pine	Standard Grading Rules for Southern Pine Lumber (September 1, 1948) of the Southern Pine Inspection Bureau, Southern Pine Association
25-13	Redwood	Standard Specifications for Grades of California Redwood Lumber (August 1, 1951) of the California Redwood Association
25-14	Bolted Joints	Wood Handbook (1940) of the Forest Products Laboratory, U.S. Department of Agriculture
25-15	Timber Connector Joints, their Strength and Design	Technical Bulletin 865 (March, 1944) of the U.S. Department of Agriculture
25-16	Lag-Screw Joints: Their Behavior and Design	Technical Bulletin 597 (January, 1938) of the U.S. Department of Agriculture
25-17	Spaced-Column Design	National Design Specification for Stress-Grade Lumber and Its Fastenings (1944, revised 1951) of the National Lumber Manufacturers' Associatior
25-18	Built-Up Members	Wood Handbook (1940) of the Forest Products Laboratory, U.S. Deartment of Agriculture
25-19	No Standard	
25-20	The Designing for Strength of Flat Panels with Stressed Coverings	Pamphlet R1220 (March, 1940, revised July, 1946) of the Forest Products Laboratory, U.S. Department of Agriculture. See U. B. Standard No. 25-25
25-21	Certificate of Inspection	See U.B.C. Standard No. 25-25
25-22	Adhesives, Types I or II	Federal Specifications C-G-456 (July 8, 1941) of the U. S. Federal Government Federal Specifications C-G-496 (September 14, 1944) of the U. S. Federal Government Joint Military Specification MIL-A-397A (April 6, 1951) of the U. S. Federal Government Joint Military Specification MIL-A-5534A (June 15, 1951) of the U. S. Federal Government
25-23	Adhesive-Tests	Tentative Method D1101-50T of the American Society for Testing Materials
25-24	No Standard	
25-25	Structural Glued Laminated Members	Standard Specifications for Design and Fabrication of Structural Glued Laminated Lumber, 1951, West Coast Lumbermen's Association

Uniform Building Code Standards (Cont'd.)

U. B. C. STD. NO.	TITLE	EXCERPTS FROM:
	CHAPTER 26	
26-1	Portland Cement	Standard Specifications C150-49 of the American Society for Testing Materials
26-2	Concrete Aggregates	Standard Specifications C33-49 of the American Society for Testing Materials
26-3	Lightweight Aggregates for Concrete	Standard Specifications C130-42 of the American Society for Testing Materials
26-4	Billet-Steel Bars for Concrete Reinforcement	Standard Specifications A15-50T of the American Society for Testing Materials.
26-5	Rail-Steel Bars for Concrete Reinforcement	Standard Specifications A16-50T of the American Society for Testing Materials
26-6	Cold-Drawn Steel Wire for Concrete Reinforcement	Standard Specifications A82-34 of the American Society for Testing Materials
26-7	Axle-Steel Bars for Concrete Reinforcement	Standard Specifications A160-50T of the American Society for Testing Materials
26-8	Making and Curing Concrete Compression and Flexure Test Specimens in the Field	Standard Method C31-49 of the American Society for Testing Materials
26-9	Test for Compressive Strength of Molded Concrete Cylinders	Standard Method C39-49 of the American Society for Testing Materials
26-10	Making and Curing Concrete Compression and Flexure Test Specimens in the Laboratory	Tentative Method C192-49 of the American Society for Testing Materials
26-11	Ready-Mixed Concrete	Standard Specifications C94-48 of the American Society for Testing Materials
26-12	Two-Way Slabs	A.C.I. Building Code Requirements for Reinforced Concrete (ACI 318-51) of the American Concrete Institute
26-13	Flat Slabs	A.C.I. Building Code Requirements for Reinforced Concrete (ACI 318-51) of the American Concrete Institute
26-14	Deformed Steel Bars for Concrete Reinforcement	Tentative Specifications A305-50T of the American Society for Testing Materials
	CHAPTER 27	
27-1	Steel for Bridges and Buildings	Standard Specifications A7-50T of the American Society for Testing Materials
27-2	Heavy and Light Gauge Structural Quality Flat Hot-Rolled Carbon-Steel Sheets	Tentative Specifications A245-48T and A246-48T of the American Society for Testing Materials
27-3	Welded and Seamless Steel Pipe	Standard Specifications A53-52T of the American Society for Testing Materials

Uniform Building Code Standards (Cont'd.)

U. B. C. STD. NO.	TITLE	EXCERPTS FROM:
27-4	Mild- to Medium-Strength Carbon-Steel Castings for General Applications	Tentative Specifications A27-50T of the Amelcan Society for Testing Materials
27-5	Gray Iron Castings	Standard Specifications A48-48 of the American Society for Testing Materials
27-6	Structural Rivet Steel	Standard Specifications A141-50T of the American Society for Testing Materials
27-7	Mild Steel Arc-Welding Electrodes	Tentative Specifications A5.1-48T of the American Welding Society (A.S.T.M. A233-48T)
27-8	Arc and Gas Welding	Standard Code for Arc and Gas Welding (1946) of the American Welding Society
27-9	Design of Light Gauge Structural Members	Specification for the Design of Light Gage Steel Structural Members (January, 1949) of the American Iron and Steel Institute
	CHAPTER 28	
28-1	Round Timber Piles	Standard Specifications D25-37 of the American Society for Testing Materials
28-2	Preservative Treatment of Piles by Pressure Processes	Standard Specifications C1-51, C2-51, C3-51, C12-51 of the American Wood Preservers' Association
28-3	Welded and Seamless Steel Pipe Piles	Standard Specifications A252-46 of the American Society for Testing Materials
	CHAPTER 30	
30-1	Dampers	Pamphlet 90 (January, 1950), of the National Board of Fire Underwriters
	CHAPTER 32	
32-1	Wood Shingles	Commercial Standard CS31-38 of the U.S. Department of Commerce, National Bureau of Standards
	CHAPTER 37	
37-1	Fireclay Refractories	Standard Specifications C27-41 of the American Society for Testing Materials
37-2	Fire-Clay Flue Lining	Standard Specifications C71-47 of the American Society for Testing Materials
	CHAPTER 38	
38-1	Installation of Sprinkler Equipments	Pamphlet 13 (June, 1951) of the N. B. F. U.
38-2	Fire Extinguishing Systems	Pamphlet 12 (March, 1951) of the N. B. F. U.
	CHAPTER 42	
42-1	Tunnel Test	Standard Test Method for Fire Hazard Classification of Building Materials, Subject 723, August, 1950, Underwriters' Laboratories, Inc.

Uniform Building Code Standards (Cont'd.)

U. B. C. STD. NO.	TITLE	EXCERPTS FROM:
	CHAPTER 43	
42-2	Prefabricated Acoustical-Units Standard Fire Tests	Federal Specification SS-A-118a (February 12, 1948) U. S. Federal Government
43-1	Fire Tests of Building Construction and Materials	Standard Methods E119-50 of the American Society for Testing Materials
43-2	Fire Tests of Door Assemblies	Standard Methods E152-41 of the American Society for Testing Materials
43-3	Tin-Clad Fire Doors and Shutters	Standard Subject 10(A), July, 1951, of Underwriters' Laboratories, Inc.
43-4	Protection of Openings in Walls and Partitions Against Fire	Pamphlet 80 (1941) of the National Board of Fire Underwriters
43-5	Structural Clay Load-Bearing Wall Tile	(See U.B.C. Standard No. 24-7)
	CHAPTER 47	
47-1	Sand for Use in Plastering	Standard Specifications C35-39 of the American Society for Testing Materials
47-2	Gypsum Plasters	Standard Specifications C28-50 of the American Society for Testing Materials
47-3	Keene's Cement	Standard Specifications C61-60 of the American Society for Testing Materials
47-4	Wood Lath	Standard Specifications for Gypsum Plastering (A42.1-1946) of the American Standards Association
47-5	Gypsum Lath	Standard Specifications C37-50 of the American Society for Testing Materials
47-6	Metal and Wire Lath	Standard Specifications for Gypsum Plastering (A42.1-1946) of the American Standards Association
	CHAPTER 48	
48-1	Storage and Handling of Photographic and X-Ray Nitrocellulose Films	Pamphlet 41 (July 15, 1930) of the National Board of Fire Underwriters
48-2	Nitrocellulose Motion Picture Film	Pamphlet 40 (1947) of the N. B. F. U.
	CHAPTER 49	
49-1	Mechanical Refrigeration	Standard Safety Code for Mechanical Refrigeration (15-39) of the American Society of Refrigerating Engineers
	CHAPTER 51	
51-1	Liquefied Petroleum Gases	National Fire Codes (1951) of the National Board of Fire Underwriters

Sec. 6003. Ordinance No.....and all ordinances amendatory thereto, and all ordinances or parts of ordinances in conflict with this Ordinance are hereby repealed. Ordinances Repealed

Sec. 6004. This Ordinance shall be, and is hereby declared to be in full force and effect, from and after 30 days from its date of final passage and approval. Date Effective

APPENDIX

The Appendix, pages 254-272, contains suggested ordinances covering subjects which may not be desired in all cities, also other pertinent information designed to be of assistance to the Building Official.

REVIEWING STANDS

Reviewing Stands

Refer to Sec. 702 (c). The following suggestions are given as a guide for the detailed design and construction of reviewing stands:

Every reviewing stand shall be constructed with four-inch by six-inch (4"x6") girders running parallel to the front of such stand, spaced not more than six feet (6') apart, and supported at distances not exceeding six feet (6') apart by posts of not less than four inches by six inches (4"x6"). These posts shall be braced diagonally with one-inch by six-inch (1"x6") bracing, forming a continuous herringbone bracing, the full length of such stand for each vertical six feet (6') of such posts. The girders at the top of the posts shall be braced with braces not less than four inches by four inches (4"x4") at right angles to the joists above the girders. Every post or brace shall be thoroughly secured to a foot plate, which shall be of sound wood not less than two inches by six inches (2"x6") in cross section laid solidly on the ground at right angles to the front of the stand and forming the base for each line of posts. There shall be joists resting on the girders of not less than two inches by eight inches (2"x8") cross section. Such joists shall be spaced not exceeding forty inches (40") apart and two-inch (2") plank shall be used for the seats and steps. Braces shall be provided whenever necessary to make a solid, substantial structure, which shall be safe under any possible emergency. All timbers forming the framing shall be thoroughly spiked together. There shall be a level stringer of two inches by six inches (2"x6") cross section at the bottom of each line of posts, parallel to the stand; also a horizontal piece of two inches by six inches (2"x6") cross section the full length of the stand and at right angles to same for every row of posts, and every six feet (6') of vertical height thereof. All timbers used in the construction of reviewing stands shall be sound (no second-hand or broken lumber permitted). Wherever the stand, or a portion thereof, extends over an excavation, the posts shall be extended to the bottom of said excavation and shall be braced with horizontal braces as hereinbefore provided.

EXISTING BUILDINGS

Existing Buildings

Sec. 1309. (a) Purpose. The purpose of this Section is to provide a reasonable degree of safety to persons living and sleeping in apartment houses and hotels through providing for alterations to such existing buildings as do not conform with the minimum safety requirements of this Code.

Existing Buildings (Cont'd.)

(b) **Scope.** The provisions of this Section shall apply exclusively to existing non-conforming Group H occupancies more than two stories in height.

(c) **Effective Date.** Eighteen months after the effective date of this Section, every building falling within its scope shall be vacated until made to conform to the requirements of this Section.

(d) **Number of Exits.** Every apartment and every other sleeping room shall have access to not less than two exits. A fire escape as specified herein may be used as one required exit.

(e) **Stair Construction.** All stairs shall have a minimum run of nine inches (9") and a maximum rise of eight inches (8") and a minimum width exclusive of handrails of thirty inches (30"). Every stairway shall have at least one handrail. A landing having a minimum horizontal dimension of thirty inches (30") shall be provided at each point of access to the stairway.

(f) **Interior Stairways.** Every interior stairway shall be enclosed with walls of not less than one-hour fire-resistive construction.

Where existing partitions form part of a stairwell enclosure, wood lath and plaster in good condition will be acceptable in lieu of one-hour construction. Doors to such enclosures shall be protected by self-closing Class "B" fire doors or solid wood doors not less than one and three-eighths inch (1⅜") thick. Enclosures shall include landings between flights and any corridors, passageways or public rooms necessary for continuous exit to the exterior of the building.

The stairway need not be enclosed in a continuous shaft if cut off at each story by the fire-resistive construction required by this Subsection for stairwell enclosures.

Enclosures shall not be required if an automatic sprinkler system is provided for all portions of the building except bedrooms, apartments and rooms accessory thereto.

(g) **Exterior Stairways.** Exterior stairs shall be incombustible or of wood of not less than two-inch (2") nominal thickness with solid treads and risers.

(h) **Fire Escapes.** Fire escapes may be used as one means of egress, if the pitch does not exceed 60 degrees, the width is not less than eighteen inches (18"), the treads are not less than four inches (4") wide, and they extend to the ground or are provided with counterbalanced stairs reaching to the ground. Access shall be by an opening having a minimum dimension of twenty-nine inches (29") when open. The sill shall be not more than thirty inches (30") above the floor and landing.

(i) **Doors.** Exit doors shall swing in the direction of exit travel, shall be self-closing and shall be openable from the inside without the use of key or any special knowledge or effort. Doors shall not reduce the required width of stairway more than six inches (6") when open.

Existing Buildings (Cont'd.)

(j) **Exit Signs.** Every exit doorway or change of direction of a corridor shall be marked with a well lighted exit sign having letters at least five inches (5") high.

(k) **Enclosure of Vertical Openings.** Elevators, shafts, ducts and other vertical openings shall be enclosed as required for stairways in Subsection (f) or by wired glass set in metal frames. Doors shall be incombustible, or as regulated in Subsection (f).

(l) **Separation of Occupancies.** Occupancy separations shall be provided as specified in Section 503. Lobbies, and public dining rooms not including cocktail lounges, shall not require a separation if the kitchen is so separated from the dining room. Boiler rooms or heater rooms containing a central heating plant using solid or liquid fuel shall be separated from the rest of the building by a "Special Occupancy Separation."

(m) **Alternates.** No alternate method of obtaining the fire protection and safety required by this Section may be used unless the Board of Examiners and Appeals, including as a voting member for this purpose the Chief of the Fire Department, finds that such alternate method provides protection and safety equivalent to that required herein.

Refer to Sec. 2301.

Weights of Building Materials

WEIGHTS OF BUILDING MATERIALS

	Lbs. Per Cu. Ft.
Brick, pressed	150
Brick, common	125
Brick, common, laid ⅜" joints	120
Brick, soft, laid ⅜" joints	100
Cast iron	450
Cinders, dry, bituminous, in bulk	45
Concrete—	
Cinder, structural	110
Stone or gravel	144
Concrete building tile, 60% solid	87
Concrete building tile, 55% solid	79
Earth—	
Common loam, dry and loose	76
Clay and gravel, dry and loose	100
Common earth, dry and packed	100
Wet mud	120
Glass	157
Granite	170
Gravel, dry	120
Granite masonry, dressed	165
Granite masonry, rubble	155
Limestone masonry, dressed	162
Marble masonry, dressed	170
Mortar, hard, cement	135
Mortar, hard, lime	105

Weights of Building Materials (Cont'd.)

	Lbs. Per Cu. Ft.
Slag (blast furnace)	180
Steel	490
Terra cotta, filled with brickwork	120
Terra cotta, Dennison interlock tile, laid	65
Timber—	
Fir, dry	32
Fir, wet	44
Oak	46
Water, fresh at 60 degrees Fahrenheit	62½
Sand, dry	100
Sand, wet	120

	Lbs. Per Sq. Ft.
Ceilings—	
Wood, lath and plaster	8
Metal lath and plaster suspended	10
Partitions—	
2"x4" studs, wood lath, ⅝" plaster, both sides	16
2"x4" studs, plaster board, ⅝" plaster, both sides	16
Channel studs, metal lath, cement plaster, solid 2" thick	20
Plaster on hollow clay tile (one side)	5
2" hollow clay tile	13
3" hollow clay tile	16
4" hollow clay tile	18
5" hollow clay tile	20
6" hollow clay tile	25
8" hollow clay tile	30
12" hollow clay tile	45
Plaster on plaster block partitions (one side)	5
2" plaster blocks	7
2½" plaster blocks	8.5
3" plaster blocks	9.5
3½" plaster blocks	10.5
4" plaster blocks	12
5" plaster blocks	15
6" plaster blocks	18
8" plaster blocks	22
Roofings—	
Wood shingles	3
Slate 3/16"	7
Slate ¼"	10
Tile and clay shingles	11 to 14
Roman tile, clay	12
Spanish tile, clay	19
Ludowici tile, Spanish	10
Tile roof laid in mortar, add	10
Copper (if no weight is specified)	1½
Tin	1
Corrugated iron	2
Tar and gravel	6
Prepared composition	1
Skylights, metal covered, wire glass	5

LATERAL BRACING

Lateral Bracing (Earthquake Regulations)

Refer to Sec. 2312. The following provisions are suggested for inclusion in the Code by cities located within an area subject to earthquake shocks:

Sec. 2312. (a) **General.** Every building or structure and every portion thereof, except Type V buildings of Group I occupancy which are less than twenty-five feet (25′) in height, and minor accessory buildings, shall be designed and constructed to resist stresses produced by lateral forces as provided in this Section. Stresses shall be calculated as the effect of a force applied horizontally at each floor or roof level above the foundation. The force shall be assumed to come from any horizontal direction.

All bracing systems both horizontal and vertical shall transmit all forces to the resisting members and shall be of sufficient extent and detail to resist the horizontal forces provided for in this Section and shall be located symmetrically about the center of mass of the building or the building shall be designed for the resulting rotational forces about the vertical axis.

Junctures between distinct parts of buildings, such as wings which extend more than twenty feet (20′) from the main portion of the building, shall be designed at the juncture with other parts of the building for rotational forces, or the juncture may be made by means of sliding fragile joints having a minimum width of not less than eight inches (8″). The details of such joints shall be made satisfactory to the Building Official.

(b) **Horizontal Force Formula.** In determining the horizontal force to be resisted, the following formula shall be used:

$$F = CW$$

WHERE

"F" equals the horizontal force in pounds,

"W" equals the total dead load,

tributary to the point under consideration, except for warehouses and tanks, in which case "W" shall equal the total dead load plus the total vertical designed live load tributary to the point under consideration. Machinery or other fixed concentrated loads shall be considered as part of the dead load.

"C" equals a numerical constant as shown in Table No. 23-C.

(c) **Foundation Ties.** In the design of buildings of Types I, II and III, where the foundations rest on piles or on soil having a safe bearing value of less than 2000 pounds per square foot, the foundations shall be completely interconnected in two directions approximately at right angles to each other. Each such inter-connecting member shall be capable of transmitting by both tension and compression at least 10 per cent of the total vertical load carried by the heavier only of the footings or foundations connected. The minimum gross size of each such member if of reinforced

TABLE NO. 23-C—HORIZONTAL FORCE FACTORS

Lateral Bracing (Cont'd.)

PART OR PORTION	VALUE OF "C"*	DIRECTION OF FORCE
Floors, roofs, columns and bracing in any story of a building or the structure as a whole**	$\frac{.15}{N\dagger + 4\frac{1}{2}}$	Any direction horizontally
Bearing walls, non-bearing walls, partitions, free standing masonry walls over 6' in height	.05 With a minimum of five pounds per square foot	Normal to surface of wall
Cantilever parapet and other cantilever walls, except retaining walls	.25	Normal to surface of wall
Exterior and interior ornamentations and appendages	.25	Any direction horizontally
When connected to or a part of a building: towers, tanks, towers and tanks plus contents, chimneys, smokestacks and penthouses.	.05	Any direction horizontally
Tanks, elevated tanks, smokestacks, standpipes and similar structures not supported by a building.	.025	Any direction horizontally

*See Map on inside back cover for zones. The values given "C" are minimum and should be adopted in locations not subject to frequent seismic disturbances as shown in Zone 1. For locations in Zone 2, "C" shall be doubled. For locations in Zone 3, "C" should be multiplied by 4.

**Where wind load as set forth in Section 2307 would produce higher stresses, this load shall be used in lieu of the factor shown.

†N is number of stories above the story under consideration, provided that for floors or horizontal bracing, N shall be only the number of stories contributing loads.

concrete shall be twelve inches by twelve inches (12"x12") and shall be reinforced with not less than the minimum reinforcement specified in Section 2620. If the inter-connecting members are of structural steel, they shall be designed as provided in Section 2702, and encased in concrete. A reinforced concrete slab may be used in lieu of inter-connecting tie members, providing the slab thickness is not less than one forty-eighth of the clear distance between the connected foundations; also providing the thickness is not less than six inches (6").

Inter-connecting slabs shall be reinforced with not less than eleven-hundredths square inch (.11 sq. in.) of steel per foot of slab in a longitudinal direction and the same amount of steel in a transverse direction. The bottom of such

Lateral Bracing (Cont'd.)

slab shall not be more than twelve inches (12") above the tops of at least 80 per cent of the piers or foundations. The footings and foundations shall be tied to the slab in such a manner as to be restrained in all horizontal directions.

(d) **Plans and Design Data.** With each set of plans filed, a brief statement of the following items shall be included:

1. A summation of the dead and live load of the building, floor by floor, which was used in figuring the shears for which the building is designed.

2. A brief description of the bracing system used, the manner in which the designer expects such system to act, and a clear statement of any assumptions used. Assumption as to location of all points of counter-flexure in members must be stated.

3. Sample calculation of a typical bent or equivalent.

(e) **Stresses.** For members carrying lateral forces only, and for combined stresses due to lateral forces and other loads the allowable unit stresses and the allowable load on connections may be increased 33⅓ per cent. In no case shall the section be less than required if the lateral force stress be neglected.

(f) **Detailed Requirements.** 1. **Bonding and Tying.** Cornices and ornamental details shall be bonded in the structure so as to form an integral part of it. This applies to the interior as well as to the exterior of the building.

2. **Overturning Moment.** In no case shall the calculated overturning moment of any building or structure due to the forces provided for in this Section exceed two-thirds of the moment of stability of such building or structure. Moment of stability shall be calculated using the same loads as used in calculating the overturning moment.

3. **Additions.** Every addition to an existing building or structure shall be designed and constructed to resist and withstand the forces provided for in this Section, and in any case where an existing building or structure is increased in height all portions thereof affected by such increased height shall be reconstructed to resist and withstand the forces provided for in this Section.

4. **Alterations.** No existing building or structure shall be altered or reconstructed in such a manner that the resistance to the forces provided for in this Section will be less than that before such alteration or reconstruction was made; provided, however, that this provision shall not apply to nonbearing partitions, and shall not apply to other minor alterations which are made in a manner satisfactory to the Building Department.

5. **Building Separations.** All portions of buildings and structures shall be designed and constructed to act as an integral in resisting lateral forces unless structurally separated by a distance of at least one inch (1"), plus one-half inch (½") for each ten feet (10') of height above twenty feet (20').

(g) **Lime Mortars.** Lime mortars shall not be used in any unit masonry construction forming a part of a building.

(h) **Veneer Ties.** Veneer ties provided in Section 2902 (c) shall be of sufficient strength to support four times the weight of the attached veneer.

(i) **Intention or Interpretation of Lateral Force Provisions.** These lateral force requirements are intended to make buildings earthquake-resistive. The provisions of this Section apply to the buildings as a unit and also to all parts thereof, including the structural frame or walls, floor and roof systems, and other structural features.

The provisions incorporated in this Section are general and, in specific cases, may be interpreted or added to as to detail by rulings of the Building Official in order that the intent shall be fulfilled.

Refer to Section 2415.

Masonry of Unburned Clay Units

Sec. 2415. (a) **Soil.** The soil shall contain sufficient clay to bind the particles together when an asphalt stabilizer is used but shall not contain more than 0.2 per cent of water-soluble salts.

(b) **Stabilizer.** The stabilizing agent shall be emulsified asphalt, portland cement, or other approved material, and shall be uniformly mixed with the soil in amounts sufficient to provide the required resistance to absorption.

(c) **Sampling.** Each of the tests prescribed in this Section shall be applied to five sample brick selected at random from each 5000 brick to be used.

(d) **Compressive Strength.** The brick shall have an average compressive strength of 300 pounds per square inch. One sample out of five may have a compressive strength not less than 250 pounds per square inch.

(e) **Modulus of Rupture.** Bricks shall average 50 pounds per square inch in modulus of rupture, when tested by applying a centrally located concentrated load at a uniform rate by the use of two-inch (2") cylinders to a unit having a test span of four inches (4") less than its length.

(f) **Moisture Content.** The moisture content of the brick shall be not more than four per cent, by weight.

(g) **Absorption.** A dried four-inch (4") cube cut from a sample brick shall absorb not more than two and one-half per cent moisture, by weight, when placed upon a constantly water-saturated porous surface for seven days.

(h) **Shrinkage Cracks.** No brick shall contain more than three shrinkage cracks and no shrinkage crack shall exceed three inches (3") in length or one-eighth inch (⅛") in width.

(i) **Mortar.** Mortar shall be portland cement mortar composed of one part portland cement to not more than three parts of dry loose aggregate.

(j) **Weathering.** A unit when exposed to water sprayed at 20 pounds pressure for two hours from a standard four-inch (4") shower head set seven inches (7") from its face shall not show an erosion of more than one-sixteenth inch (1/16") nor any appreciable pitting.

(k) **Footings.** Footing walls shall be of concrete, burned

Masonry of Unburned Clay Units (Cont'd.)

TABLE NO. 24-I—WORKING STRESSES IN MASONRY OF UNBURNED CLAY UNITS
(Pounds per Square Inch Gross Area)

TYPE OF MORTAR	COMPRESSION	TENSION IN FLEXURE	SHEAR
A-1, A-2, or B	30	4	4

clay units, or solid concrete units, and shall extend not less than six inches (6") above the adjacent ground at all points.

(l) **Laying.** At the time of laying, units shall be free of foreign material. Joints shall be solidly filled with mortar. Bond shall be provided as required for masonry of hollow units in Section 2408 (b).

(m) **Limitations.** Masonry of unburned clay units shall not be used in any building more than one story in height.

No bearing wall of unburned clay units shall have a height of more than 10 times the thickness of such walls, and the thickness shall in no case be less than sixteen inches (16").

Fireplaces and chimneys of unburned clay units shall be lined with fire brick not less in thickness than four inches (4").

(n) **Allowable Stresses.** The maximum allowable working stresses in masonry of unburned clay units shall not exceed the values set forth in Table No. 24-I except as provided in Chapter 23.

Termite Provisions

TERMITE PROVISIONS

Refer to Sec. 2525. The following precautions are recommended for territories where foundation timber is subject to special hazard of decay and termite damage:

1. Before any new building is erected all stumps and roots shall be removed from the soil to a depth of at least twelve inches (12") below the surface of the ground in the area to be occupied by the building.

2. All wood members used to support permanently a load of any kind, in buildings over four hundred square feet (400 sq. ft.) in area, shall be of the grade and kind of lumber specified in Section 2204 when any part of such member is placed within eighteen inches (18") of any earth, either natural ground or earth fill.

3. Wood posts or columns shall not extend through or be placed directly on concrete floors. They shall be supported on concrete footings extending at least two inches (2") above the finished floor or may be placed on a corrosion-resisting metal plate at least one-sixteenth inch (1/16") thick and not smaller than the base of the post or column. Such plate may be flush with the concrete floor.

4. Where timbers extend into a masonry wall at a point below the level of the ground outside of the wall, metal wall boxes shall be provided or the end and all surfaces of the timber within one foot (1') of the end shall be painted with at least two coats of hot coal tar creosote or other approved wood preservative.

5. All wood forms which have been used in placing concrete, if within the ground or less than eighteen inches (18") above the ground, shall be removed before a building is occupied or used for any purpose. Termite Provisions (Cont'd.)

6. Loose or casual wood shall not be stored in direct contact with the ground under any building.

PHOTOGRAPHIC AND X-RAY FILMS

Refer to Chapter 48. The following provisions are recommended for inclusion in the Code where provisions covering the handling and storage of photographic and X-ray nitrocellulose films are desired: Photographic and X-ray Films

Sec. 4801. The provisions of this Chapter do not apply to: Classes of Film Excepted

1. Film for amateur photographic use in original packages of "roll" and "film pack" films in quantities of less than fifty cubic feet (50 cu. ft.).
2. Safety film (cellulose acetate base).
3. Dental X-ray film.
4. Establishments manufacturing photographic films and storage incidental thereto.
5. Films stored or being used in standard motion picture booths (see Chapter 40).

Safety photographic and X-ray film (cellulose acetate base) may be identified by the marking on the edge of the film. This marking shows plainly before and after developing. Where film is not so marked it shall be inspected to determine whether it is of the safety acetate or nitrate type.

Sec. 4802. All regulations for the storage and handling of photographic and X-ray nitrocellulose films shall conform to U.B.C. Standard No. 48-1. General Regulations

EXCEPTION: Where definite fire-resistive materials are specified, materials of equal fire resistance as specified in this Code may be used.

Sec. 4803. The storage and handling of nitrocellulose motion picture film shall conform to U.B.C. Standard No. 48-2. Motion Picture Film

REFRIGERATION SYSTEMS

Refer to Chapter 49. Where it is desired to regulate the installation or alteration of refrigeration systems, the following provisions are recommended for inclusion in the Code: Refrigeration Systems

Sec. 4901. It shall be unlawful for any person, firm or corporation to install or alter or cause to be installed or altered, any system of refrigeration, unless such system is an approved type and is installed in accordance with the provisions of U.B.C. Standard No. 49-1. General

Sec. 4902. Regulations of this Chapter shall apply to all refrigeration systems hereafter installed and to alterations of and additions to such existing systems. Scope

CHAPTER 51—HEAT PRODUCING APPLIANCES

Construction, Installation and Performance Requirements

Sec. 5101. (a) **General.** Heat-producing appliances other than electrical shall conform to the requirements of this Chapter.

(b) **Approvals.** Each heat-producing appliance and accessory shall be of a type complying with applicable nationally recognized standards as determined by an approved testing agency.

Where no such standards exist approval of the Building Official shall be obtained before the appliance or accessory is installed.

(c) **Type of Fuel.** Each appliance shall be designed for use with the type of fuel to which it will be connected. No appliance shall be converted from the fuel specified on the rating plate for use with a different fuel without consulting the manufacturer for complete instructions and securing reapproval from the Building Official.

(d) **Installation.** The installation of heat-producing appliances covered by this Chapter shall conform to the conditions of approval as specified in the manufacturer's instructions pertaining to safety and to the requirements of this Chapter. The installer shall leave the manufacturer's instructions attached to the appliance for the benefit of the Building Official.

(e) **Shut-Off Valves.** A readily accessible lever handle shut-off cock shall be installed in the fuel piping outside of each appliance and ahead of the union connection thereto in addition to the valve provided on the appliance.

EXCEPTION: Shut-off valves may be accessibly located inside or under appliances when such appliance can be removed without removal of the shut-off valve.

(f) **Connections.** 1. All gas and liquid fuel-burning heat-producing appliances shall be rigidly connected to the fuel piping outlet with solid iron pipe except as hereafter provided.

2. Before any contemplated use of existing lines, pipe sizes shall be verified through the proper administrative authorities. If such piping is found inadequate, separate fuel lines shall be installed from source to the heating appliance.

3. Semi-rigid seamless tubing may be used to connect any oil-burning appliance. The maximum length shall be three feet (3′) and it shall be of an approved type. The capacity shall be that required by the appliance. Such tubing shall not pass through any wall, floor or partition.

4. Gas appliances burning not more than 100,000 B.t.u. per hour may be connected with semi-rigid seamless metal tubing connectors meeting the following requirements:

Construction, Installation and Performance Requirements (Cont'd.)

The method of attaching such connectors to the gas piping and appliance shall not depend upon separate ferrules, washers, gaskets, or other detachable parts for gas tightness, nor shall such separate parts be used to establish and maintain the method of seal provided within the connector and fittings.

The capacity shall be that required by the appliance.

The over-all length of such connectors shall not exceed three feet (3').

No part of such connectors shall be concealed within or run through any wall, floor or partition.

5. A separate shut-off valve shall be installed in all gas lines within three feet (3') of the appliance. The valve shall be of the same size as the pipe in which it is installed.

6. All electrical connections and wiring shall be made in accordance with the electrical code. This shall not apply to enclosed wiring which is an integral part of any approved electrically controlled device. Gas piping shall not be used for an electrical ground or in lieu of wiring.

(g) **Clearances.** Clearances of heat-producing appliances from combustible material shall be as specified in this Chapter or as set forth in Table No. 51-A.

Fresh Air Supply for Combustion

Sec. 5102. (a) **Fresh Air Supply.** All fuel-burning appliances shall be assured a sufficient supply of fresh air for proper fuel combustion.

(b) **Space.** If the volume, in cubic feet, of the space in which fuel-burning appliances are located is less than:

1. One-twentieth of the maximum rated input in B.t.u.'s of all gas-burning appliances in such space plus

2. One-tenth of the maximum rated input in B.t.u.'s of all solid and liquid fuel-burning appliances in such space; provisions shall be made to supply this space with fresh air.

(c) **Methods of Supplying Fresh Air.** Where provisions for fresh air are required in this Section, the Building Official shall specify which of the following methods shall be used:

1. Permanent openings or ducts leading from the appliance location to the outside of the building. For gas-burning appliances, such openings or ducts shall have a total unobstructed area of not less than one square inch (1 sq. in.) per 1000 B.t.u. maximum input rating of all such appliances in the space. For solid and liquid fuel-burning appliances, such openings or ducts shall have a total unobstructed area of not less than two square inches (2 sq. in.) per B.t.u. maximum input rating of all such appliances in the space.

2. Permanent openings or ducts leading from the appliance location to other interior areas which meet the minimum required volume specified in Subsection (b) of this Section. Such openings or ducts shall be not less in size than those specified in Subsection (c)1 of this Section.

Where openings or ducts are used, they shall consist of two or more, of approximately equal area, one or more within six inches (6") of the ceiling of the appliance enclosure and one or more within six inches (6") of the floor of the appliance enclosure.

TABLE NO. 51-A—REDUCTION OF REQUIRED CLEARANCES OF APPLIANCES FROM COMBUSTIBLES
(In inches, with minimum specified forms of protection)

TYPE OF PROTECTION Applied over combustible material. The protection shall extend on each side of the appliance the same distance as the reduced clearance.*	WHERE THE REQUIRED CLEARANCE WITH NO PROTECTION IS:												
	36 Inches			18 Inches			12 inches		9 Inches	6 Inches			3 Inches
	Above	Sides and Rear	Smoke Pipe	Above	Sides and Rear	Smoke or Vent Pipe	Above	Sides and Rear	Smoke or Vent Pipe	Above	Sides and Rear	Vent Pipe	Above
(a) ¼ in. asbestos millboard spaced out 1 in.**	30	18	30	15	9	12	9	6	6	3	2	3	2
(b) 28 gauge sheet metal on ¼ in. asbestos millboard	24	18	24	12	9	12	9	6	4	3	2	2	1
(c) 28 gauge sheet metal spaced out 1 in.**	18	12	18	9	6	9	6	4	4	2	2	2	2
(d) 28 gauge sheet metal on ⅛ in. asbestos millboard spaced out 1 in.**	18	12	18	9	6	9	6	4	4	2	2	2	2
(e) 1½ in. asbestos cement covering on heating appliance	18	12		9	6	3	6	4		2	1	2	1
(f) ¼ in. asbestos millboard on 1 in. rockwool bats reinforced with wire mesh or equivalent	18			6			4	4	4	2	2	2	2
(g) 22 gauge sheet metal on 1 in. rockwool bats reinforced with wire mesh or equivalent	18		12	4			2	2	2	2	2		2
(h) ¼ in. asbestos cement board or ¼ in. asbestos millboard	—	—	—	—	—	—	—	—	—	4	4	4	2
(i) ¼ in. cellular asbestos	—	—	—	—	—	—	—	—	—	3	3	3	1

*All clearances shall be measured from the outer surface of the appliance to the combustible material disregarding any intervening protection applied to the combustible material. A dash indicates no reduction in clearance permitted.
**Spacers shall be of noncombustible material.

Access

Sec. 5103. (a) **General.** Every heat-producing appliance shall be accessible for inspection, service, repair, and replacement without removing permanent construction. Sufficient room shall be available to enable the operator to observe the burner, control, and pilot while starting the appliance. The operating instructions must be in a position where they can be easily read.

(b) **Furnace or Boiler Room.** Each furnace or boiler room shall have an opening or door and passageway large enough to permit removal of the largest piece of the furnace.

(c) **Horizontal Suspended Furnaces or Attic Furnaces.** The space in which any attic furnace is installed shall be accessible by an opening and passageway as large as the largest piece of the furnace, but not less than thirty inches by thirty inches (30" x 30") and shall be continuous from the opening to the furnace control and valves. The opening to the passageway shall be located not more than twenty feet (20') from the furnace. An electric light shall be provided at or near the furnace location, controlled by a switch located ahead of the passage opening. Every passageway shall have solid continuous flooring not less than twenty-four inches (24") wide from the entrance opening to the furnace. A ladder permanently fastened to the building or equal access shall be provided leading to the attic opening.

(d) **Floor Furnace.** The space in which any floor furnace or horizontal suspended furnace is installed shall be accessible by an opening in the foundation not less than twenty-four by eighteen inches (24" x 18") or trapdoor not less than eighteen by twenty-four inches (18" x 24") in any cross-section thereof, and a passageway not less than eighteen by twenty-four inches (18" x 24") in any cross-section thereof. The passageway shall be continuous from the opening or trapdoor to the furnace controls and valves, and the opening to the passageway shall be located not more than twenty feet (20') from the furnace.

(e) **Water Heaters.** Access to water heaters installed in an attic must comply with the provisions of Subsection (c) of this Section to provide suitable access.

Residential Space Heating Devices and Controls

Sec. 5104. (a) **Automatic Devices for Use on Residential Space Heating Appliances.** 1. All natural, manufactured or mixed gas-burning appliances shall be equipped with approved devices which will shut off the gas to the main burner or burners in the event of pilot failure.

EXCEPTION: Manually controlled floor furnaces and manually controlled room heaters.

2. Liquefied petroleum or mixed liquefied petroleum gas-air-burning appliances shall be equipped with automatic devices which will shut off the flow of gas to the pilot and main burner or burners in the event of pilot failure.

3. Liquid fuel burning appliances shall be equipped with approved devices to shut off the fuel supply to the main burner or burners in the event of ignition failure.

(b) **Remote Controls.** All heating appliances whose manual controls are not readily accessible from the main

Residential Space Heating Devices and Controls (Cont'd.)

portion of the dwelling being heated shall be equipped with remote controls.

EXCEPTION: Hand-fired solid or liquid fuel-burning equipment.

(c) **Limit Controls.** Where a gravity warm air heating system is installed with at least one warm air outlet not less than thirty-five square inches (35 sq. in.) and permanently open and unobstructed, except for an open-faced grille, a temperature limit control will not be required on the appliance. If a control is required, it shall be of an approved type set at 250° F. and located in the bonnet or plenum of the appliance.

Space Heating Furnaces and Boilers

Sec. 5105. (a) **General.** The equipment covered by this Section shall be installed according to the provisions of this Chapter. Such equipment shall not be altered nor shall the fuel input be increased in excess of the manufacturer's rated input. Defective material or parts shall be replaced in such a manner as not to invalidate the approvals as specified in Section 5101 (b).

(b) **Labeling.** Each furnace or boiler shall bear a permanent and legible name plate on which shall appear:

The manufacturer's name.

The manufacturer's rating of the appliance.

A model and serial number.

Instructions for the lighting, operation and shutdown of the appliance.

The type of fuel approved for use in the appliance.

A seal of approval of the appliance by an approved testing laboratory if acceptance is based on such approval.

(c) **Air Supply for Combustion.** Air for combustion shall be supplied as specified in Section 5102.

(d) **Circulating Air Supply.** Circulating air used for conveying heat and for ventilation may be taken from outside the building, from rooms used for living quarters inside the building or from both sources. Such circulating air shall be conducted to blower-type furnaces in continuous ducts or incombustible material.

Circulating air supply openings or ducts for gravity type warm air furnaces shall have a total net area of not less than two square inches (2 sq. in.) for each 1,000 B.t.u. maximum input of all such furnaces being supplied. In no case shall the total net area of such openings or ducts be less than two hundred square inches (200 sq. in.).

Circulating air for blower type warm air furnaces shall be conducted into the blower housing from outside the furnace space by continuous air-tight ducts.

No circulating air supply inlet for blower type warm air furnaces shall be located in the following positions:

1. Closer than ten feet (10′) from any appliance firebox or draft diverter which is located in the same enclosed space as the air supply inlet.
2. Closer than ten feet (10′) from any appliance vent outlet.

Space Heating Furnaces and Boilers (Cont'd.)

3. Where it will pick up objectionable odors, fumes or flammable vapors.
4. Where it is located in the same enclosed space as the combustion air inlet.

No damper shall be placed in any air intake, except that a diverting damper may be placed in a combination fresh air intake and return air intake so arranged that for all possible positions of the damper, the cross-sectional area of the circulating air intake to the furnace is not less than the total cross-sectional area of all hot air outlets.

(e) **Venting.** Heating furnaces or boilers covered by this Section shall be connected to a vent or chimney complying with Chapter 37 of this Code.

(f) **Location.** 1. Heating furnaces shall not be installed in an attic unless of a type approved for such use.

2. Floor furnaces may be installed in an upper floor provided the furnace assembly projects below into a utility room closet, garage, or similar non-habitable space. In such installations where fire separation is required the furnace shall be entirely separated from the non-habitable space by means of the required fire-resistive construction. Adequate means for air intake and service access shall be provided. Minimum furnace clearance of six inches (6") on all sides shall be maintained between the furnace and enclosure.

3. No forced air or gravity central heating furnaces shall be located in any room used or designed to be used for sleeping purposes, bathroom, clothes closet, or in any confined space with access only to the above locations. No warm air furnace shall be located in or serve any surgical operating room or other hazardous location.

(g) **Mounting. 1. Heating Furnaces.** Heating furnaces and boilers except floor furnaces, shall be mounted as follows:

A central heating furnace or boiler shall be erected in accordance with the manufacturer's instructions and shall be installed on a firm, level floor of Type I construction unless listed for installation on a combustible floor or the floor is protected in an approved manner. Such construction shall in all cases extend not less than twelve inches (12") beyond the appliance on all sides, and where solid fuel is used shall extend not less than eighteen inches (18") at the front or side where ashes are removed.

Blower type warm air furnaces may be mounted on floors other than as specified in this Subsection, provided they are so arranged that the fan chamber occupies the entire area beneath the firing chamber and forms a ventilated air space between the firing chamber and the floor of not less than eighteen inches (18") in height with at least one metal baffle between the firing chamber and the floor.

Heating boilers of the water-base type may be mounted on floors other than as specified in this Subsection, provided the water chamber extends under the whole of the ash pit and firebox, or under the whole of the firing chamber if there is no ash pit.

Appliances which are set on legs which provide not less than four inches (4") open space under the base of the

Space Heating Furnaces and Boilers (Cont'd.)

appliance may be mounted on floors other than as specified in this Subsection, provided the appliance is such that flame or hot gases do not come in contact with its base, and further provided that the floor under the appliance is protected with not less than one-quarter inch (¼") of asbestos mill board covered with sheet metal of not less than 24 U. S. gauge. This specified floor protection shall extend not less than six inches (6") beyond the appliance on all sides.

Appliances which are arranged so that the flame or hot gases do not come in contact with the base may be mounted on floors other than as specified in this Subsection, provided the floor under the appliance is protected with hollow masonry not less than four inches (4") in thickness, covered with sheet metal of not less than 24 U. S. gauge. Such masonry course shall be laid with ends unsealed and joints matched in such a way as to provide a free circulation of air from side to side through the masonry.

Appliances which are arranged so that flame or hot gases come in contact with the base may be mounted on floors other than as specified in this Subsection, provided the floor under the appliance is protected by two courses of four-inch (4") hollow clay tile eight inches (8") minimum thickness or equivalent, with courses laid at right angles and with ends unsealed and joints matched in such a way as to provide a free circulation of air through such masonry courses, and covered with steel plate not less than three-sixteenths inch (3/16") in thickness.

2. Floor furnaces. The floor around the furnace shall be braced and headed with a framework of material not lighter than the joists or girders.

Floor furnaces shall be supported independently of the grilles.

The lowest portion of the floor furnace shall have at least a six-inch (6") clearance from the ground, except that where the lower six-inch (6") portion of the floor furnace is sealed by the manufacturer to prevent entrance of water, the clearance may be reduced to not less than two inches (2"). When that clearance is not present, the ground below and to the sides shall be excavated to form a "basin-like" pit under the furnace so that there is a six-inch (6") clearance beneath the lowest portion of the furnace and a twelve-inch (12") clearance on all sides, except the control side which shall have an eighteen-inch (18") clearance. Whenever the excavation exceeds twelve inches (12") in depth, or water seepage is likely, a water-tight copper pan, concrete pit, or other suitable material shall be used. A copper pan shall be made of not less than sixteen-ounce-per-square foot sheet copper. The pan shall be anchored in place, so as to prevent floating and the walls shall extend at least four inches (4") above the adjacent ground level, with twelve-inch (12") clearances on all sides except the control side, which shall have eighteen-inch (18") clearance. When the equipment is sealed by the manufacturer to meet this condition, the pan or pit may be omitted if not required for maintaining a dry condition for service access.

TABLE NO. 51-B—MINIMUM CLEARA NCES—HEATING FURNACES AND BOILERS FROM COMBUSTIBLES

HEATING FURNACES AND BOILERS	MINIMUM CLEARANCE, INCHES		
	ABOVE*	SIDES AND REAR	FRONT
Blower type warm air furnaces, automatically fired with 250° F. temperature limit control**			
Burning liquid or solid fuel	6	6	48
Burning gas	6	6	18
Hot water and steam boilers operating at not over 15 lbs. gauge pressure, of water-wall type or having a jacket or lining of masonry or other satisfactory insulating material			
Burning liquid or solid fuel	6	6	48
Burning gas	6	6	18
Heating boilers and furnaces (including warm air furnaces) other than as above			
Burning liquid or solid fuel	18	18	48
Burning gas	18	18	18

*The clearances above warm air furnaces shall be measured from the furnace bonnet or warm air plenum chamber.

**"Blower type warm air furnaces with 250° F. temperature limit control" shall be defined as automatically fired warm air furnaces equipped with a fan to circulate the air and with approved automatic temperature limit controls that cannot be set higher than 250° F. and if coal stoker fired, equipped also with an automatic overrun control to operate the fan when the air reaches a temperature not higher than 250° F. even though the controlling thermostat is not calling for heat.

Space Heating Furnaces and Boilers (Cont'd.)

TABLE NO. 51-C—MINIMUM CLEARANCES FOR APPROVED GAS-FIRED ROOM AND SPACE HEATERS

	DISTANCE FROM COMBUSTIBLE CONSTRUCTION (INCHES)	
Type	Jackets, Sides Rear	Projecting Flue Box or Hood
1. Circulating Space Heaters	6	2
2. Recessed Wall Heaters	Flush	-
3. Gas Steam Radiators	6	2
4. Radiant Heaters	6	2
5. Unit Heaters	6	6

TABLE NO. 51-D—MINIMUM CLEARANCES FOR SOLID AND LIQUID FUEL BURNING ROOM AND SPACE HEATERS

	DISTANCE FROM COMBUSTIBLE CONSTRUCTION (INCHES)
Type	Jackets, Sides Rear
1. Circulating Space Heaters	12
2. Recessed Wall Heaters	Flush
3. Radiant Heaters	36
For reduced clearances see Table No. 51-A.	

TABLE NO. 51-E—THICKNESS OF METAL FOR AIR DUCTS

Round Ducts Diameter (In Inches)	Rectangular Ducts Maximum Side (In Inches)	Galvanized Iron Minimum Thickness U. S. Gauge	Aluminum Minimum Thickness B&S Gauge	Tin Minimum Thickness Gauge
Up to 18	Up to 12	26	24	ICL
19 to 30	13 to 30	24	22	
31 to 45	31 to 60	22	20	
46 to 60	61 to 90	20	18	
61 & above	91 & above	18	16	

Floor furnaces shall not be installed where concrete slab floors are used.

(h) **Clearances. 1. Heating Furnaces.** Clearances of heating furnaces and boilers except floor furnaces from combustible material shall be as follows:

Except as herein provided, heating furnaces and boilers shall be installed to provide clearances to woodwork or other combustible material whether plastered or unplaster-

Space Heating Furnaces and Boilers (Cont'd.)

ed, not less than as set forth in Table No. 51-B. Floor-mounted direct-fired unit heaters shall be installed with clearances as set forth in Table No. 51-B for appliances of similar heat-producing characteristics.

Heating furnaces and boilers which are approved for installation with lesser clearances than specified in this Subsection, may be installed in accordance with the conditions of such approval.

2. **Floor Furnaces.** With the exception of wall-register models, a floor furnace shall not be placed closer than six inches (6") to the nearest wall, and wall-register models shall not be placed closer than six inches (6") from a corner.

The furnace shall be so placed that a door cannot be nearer than twelve inches (12") to any portion of the register of the furnace.

(i) **Ducts. 1. Length and Slope.** For gravity systems no leader heat pipes shall be over twenty feet (20') in length measured horizontally, except where a booster fan is installed, when the length shall not exceed forty feet (40'). All heat pipes under first floor joists shall have a uniform rise of at least one inch (1") per lineal foot of horizontal run.

2. **Size.** Warm air pipes and appurtenances serving first floor rooms shall have a minimum cross-sectional area in square inches of not less than the cubic foot capacity of the room or rooms in which registers are located, divided by 40; provided, that no leader pipe shall have a net area of less than fifty square inches (50 sq. in.). Risers and appurtenances serving floors above the first floor shall have a net area of not less than two-thirds that required to serve the first floor.

3. **Material.** Ducts shall be of incombustible material equivalent in structural strength, durability and thickness to the materials set forth in Table No. 51-E. Wire-glass may be used for inspection windows in ducts.

4. **Formed by Part of the Building Structure.** Ducts may be of independent construction or may be formed by parts of the building structure if they conform to the requirements of this Section. Duct walls may be of lath and plaster as approved for one-hour fire-resistive construction.

5. **Registers.** Registers shall be located in or near the wall of the room nearest the furnace. No register shall be located in outside walls unless the weather side is covered with air-cell asbestos paper.

Where double registers are supplied by one leader pipe, each register shall have a capacity of not less than two-thirds the area of the leader pipe.

6. **Construction and Installation.** Ninety-degree bends in round pipe shall be made by not less than four piece elbows. Sixty-degree bends shall be made by means of not less than three piece elbows.

All warm air pipes and fittings, cold air or circulating pipes, ducts, boxes and fittings shall be made of materials

Space Heating Furnaces and Boilers (Cont'd.)

set forth in Table No. 51-E, and shall be covered with two thicknesses of asbestos paper weighing at least eight pounds to one hundred square feet (100 sq. ft.), or with air-cell asbestos insulation, or shall be double walled, with one-quarter inch (¼") space between the inner and outer walls.

In addition, leader heat pipes under the first floor shall be kept at least three inches (3") from any combustible material or shall be protected with an asbestos shield and a one-inch (1") air space. Air-cell asbestos paper not less than one-quarter inch (¼") in thickness shall be securely cemented around all leader heat pipes.

7. **Support.** All riser pipes shall be held in place by means of metal strips securely fastened to the pipe and shall in no case be held in place by nailing diagonally through the corners of such pipe. No joint shall depend wholly upon solder to make it tight. All leader pipes shall be securely fastened in place by means of wires or metal strips.

8. **Branch or Y-Runs.** In the installation of Y-runs or branch runs, the cross-sectional area of the warm air pipe at the furnace shall equal in square inches the cubic contents of all the rooms served by such warm air pipe divided by 40.

Sizes of branch runs shall be determined in the same manner on the basis of the room or rooms served. Branches from trunk lines shall be taken off in a generally horizontal plane at an angle not more than 45 degrees from the line of the pipe. Fifteen-degree Y-branches may be permitted in forced draft systems. Riser pipes shall not be taken off the top of the first floor register boxes.

9. **Clearance between Joists or Studs.** Where warm air pipes and appurtenances are to be installed in a building, the joists and studs shall be so arranged as to provide not less than fourteen inches (14") clear space in continuous horizontal runs and vertical risers from the furnace to the register served.

10. **Air Filters.** Air filters shall be of a type that will not burn freely or emit large volumes of smoke or other objectionable products of combustion when attacked by flames. Liquid adhesive coatings used on filters shall have a flash point of 350 degrees F., Cleveland open cup tester, or higher.

(j) **Boiler Piping.** The method of connecting the flow and return pipes on steam and hot water boilers shall facilitate a rapid circulation of steam or water.

Steam pipes and hot water heating pipes shall be installed with a clearance of at least one inch (1") to all combustible construction or material, except that at the points where pipes carrying steam or hot water at not over 15 pounds gauge pressure emerge from a floor, wall or ceiling the clearance at the opening through the finish floor boards or wall ceiling boards may be less than one inch (1") but not less than one-half inch (½"). Each such opening shall be covered with a plate of non-combustible material.

Space Heating Furnaces and Boilers (Cont'd.)

Such pipes passing through stock shelving shall be covered with not less than one inch (1") of approved insulation.

Wooden boxes or casings enclosing uninsulated steam or hot water heating pipes, or wooden covers to recesses in walls in which such uninsulated pipes are placed, shall be lined with metal or asbestos mill board.

Where the temperature of the boiler piping does not exceed 160° F. the provisions of this Subsection shall not apply.

Coverings or insulation used on steam or hot water pipes shall be of incombustible material.

Room or Space Heaters

Sec. 5106. (a) **General.** The equipment covered by this Section shall be installed according to the provisions of this Chapter. Such equipment shall not be altered nor shall the fuel input be increased in excess of the manufacturer's rated input. Defective material or parts shall be replaced in such a manner as not to invalidate the approvals as specified in Section 5101 (b).

(b) **Labeling.** All equipment covered by this Section shall be labeled as specified in Section 5105 (b) for furnaces and boilers.

(c) **Venting.** Heating appliances covered by this Section shall be connected to a flue vent or chimney complying with Chapter 37 of this Code.

EXCEPTION: Gas heating appliances other than those in Group D, H and I occupancies need not be vented if designed without a vent collar and so listed and approved for use without a flue vent or chimney by a nationally recognized testing laboratory.

(d) **Location.** Room heaters shall be placed so as not to cause a hazard to walls, floors and doors. Room heaters designed and marked "for use in incombustible fire-resistive fireplace only", shall not be installed elsewhere.

(e) **Clearances. 1. Gas-fired Approved Room and Space Heaters.** Approved room and space heaters shall be installed with clearances from combustible construction as set forth in Table No. 51-C.

Circulating Space Heaters. A space heater designed to convert the energy in fuel gas to convected heat or radiant heat and convected heat, by the circulation of the products of combustion and room air, or room air only.

Recessed Wall Heaters. A space heater designed for installation within a wall or partition and approved for such use.

Steam Radiators. A space heater in which all the energy in the fuel gas (with the exception of that lost from the flue by radiation or convection from the combustion chamber) is transmitted to the surrounding atmosphere through the medium of steam or hot water generated within the appliance. In this definition, the combustion chamber is that part of the appliance in which combustion of the gas takes place and does not include the flue passages.

Radiant Heaters. A space heater designed primarily to convert the energy in fuel gas to radiant heat.

Room or Space Heaters (Cont'd.)

Unit Heaters—LOW STATIC PRESSURE TYPE. A self-contained, automatically controlled, vented, gas-burning appliance, limited to the heating of non-residential space in which it is installed. Such appliances shall have integral means for circulation of air, normally by a propeller fan or fans, and may be equipped with louvres or face extensions made in accordance with the manufacturer's approved specifications.

Unit Heaters—HIGH STATIC PRESSURE TYPE. A self-contained, automatically controlled, vented, gas-burning appliance, limited to the heating of non-residential space. These appliances have integral means for circulation of air against two-tenths inch (0.2") or greater static pressure and are designed for installation in the space to be heated unless they are equipped with provisions for attaching both inlet and outlet air ducts.

2. **Untested Room and Space Heaters.** Untested gas-fired room or space heaters shall be installed with clearances from combustible construction not less than the following:

Circulating Type. Room heaters having an outer jacket surrounding the combustion chamber, arranged with openings at top and bottom so that air circulates between the inner and outer jacket and without openings in the outer jacket to permit direct radiation shall have clearances at sides and rear of not less than 12 inches.

Radiant Type. Room heaters other than those described above as of circulating type shall have clearances at sides and rear of not less than eighteen inches (18"); except that heaters which make use of metal, asbestos or ceramic material to direct radiation to the front of the appliance shall have a clearance of thirty-six inches (36") in front, and if constructed with a double back of metal or ceramic may be installed with a clearance of eighteen inches (18") at sides and twelve inches (12") at rear.

3. **All Other Types.** All other room- or space-heaters shall have a clearance at side and rear of not less than eighteen inches (18") with the floor protected in an approved manner. Reduced clearances shall be as set forth in Table No. 51-A.

(f) **Clearances—solid and liquid fuel-burning heaters.** Clearances for solid and liquid fuel-burning room and space heaters shall be as set forth in Table No. 51-D.

Circulating Space Heaters. A circulating type space heater is one having an outer jacket surrounding the casing around the combustion chamber, arranged with openings at top and bottom so that air circulates between the inner casing and the outer jacket. Space heaters with openings in the outer jacket to permit some direct radiation from the inner casing shall be classed as radiating type.

Recessed Wall Heaters. A space heater designed for installation within a wall or partition and approved for such use.

Radiant Heaters. A space heater designed primarily to convert the energy in fuel to radiant heat.

(g) **Support.** Suspended type unit heaters shall be

safely and adequately supported with due consideration given to their weight and vibration characteristics.

Room or Space Heaters (Cont'd.)

(h) **Mounting.** Except as otherwise provided, floor-mounted heating appliances shall be mounted on the ground, or on floors of Type I construction or fire-resistive construction with incombustible flooring and surface finish, or on fire-resistive slabs or arches having no combustible material against the underside thereof. Such construction shall in all cases extend not less than six inches (6") beyond the appliance on all sides, and where solid fuel is used shall extend not less than eighteen inches (18") at the front or side where ashes are removed.

Floor-mounted heating appliances which are approved specifically for installation on a combustible floor may be mounted in accordance with the conditions of such approval.

Floor-mounted heating appliances, which are set on legs which provide not less than four inches (4") open space under the base of the appliance may be mounted on floors other than as specified in this Subsection, provided the floor under the appliances is protected with sheet metal of not less than 24 U. S. gauge or by other approved incombustible material. Where solid fuel is used the protection shall extend not less than eighteen inches (18") beyond the appliance at the front or side where ashes are removed. With radiating type space heaters burning gas, which make use of metal, asbestos or ceramic material to direct radiation to the front of the device, the floor protection shall extend out at the front not less than thirty-six inches (36") when the heater is not of a type approved for installation on a combustible floor.

Floor-mounted heating appliances which are set on legs which provide not less than eighteen inches (18") open space under the base of the appliance, or which have no burners and no portion of any firebox within eighteen inches (18") of the floor, may be mounted on floors other than as specified in this Subsection, without special floor protection, provided there is at least one sheet metal baffle between the burners or firebox and the floor.

Floor-mounted heating appliances may be mounted on floors other than as specified in this Subsection, provided the floor under the appliance is protected with hollow masonry not less than four inches (4") in thickness, covered with sheet metal of not less than 24 U. S. gauge. Such masonry course shall be laid with ends unsealed and joints matched in such a way as to provide a free circulation of air from side to side through the masonry. Where solid fuel is used the floor for eighteen inches (18") beyond the front of the appliance or side where ashes are removed shall be protected with sheet metal of not less than 24 U. S. gauge, or with protection equivalent thereto.

Water Heaters

Sec. 5107. (a) Prohibited Locations. No water heater shall be installed in any room used or designed to be used for sleeping purposes, bathroom, clothes closet, or under any stairway or landing, or in any confined space with access only to the above locations.

Water Heaters (Cont'd.)

(b) **Water Heaters Installed in Garages.** Water heaters installed in garages shall be adequately guarded against mechanical injury and from coming in contact with combustible material.

(c) **Water Heater Enclosures or Recesses.** An enclosure or recess used to house a water heater shall be of such size that the heater is readily accessible for adjustment, service, or replacement and provides adequate clearance as specified in Subsection (e). When water heaters are installed in attics, access to such space shall comply with the provisions of Section 5103 (c) of this Chapter. Ceiling construction shall be maintained where any heater would otherwise project partially into an attic space.

(d) **Air for Combustion.** Air for combustion shall be supplied as specified in Section 5102.

(e) **Clearances.** Water heaters may be positioned in relation to combustible construction with minimum clearance as follows:

1. Approved gas-fired circulating tank, instantaneous, and uninsulated underfired types....6"
2. Approved gas under-fired, insulated automatic storage types.....2"
3. Approved gas under-fired, insulated automatic storage types (with one or more flat sides) .....Flush
4. Untested gas-fired or types burning solid or liquid fuel.....12"

In no case shall the clearance be reduced so as to interfere with the requirements for accessibility and combustion air.

Approved liquid fuel-burning water heaters may be placed in relation to combustible construction as specified under conditions of approval and listings.

Reduced clearances shall be as set forth in Table No. 51-A.

(f) **Relief Valves.** All water heating appliances which are installed in a closed system of water piping, or any water heater connected to a separate storage tank and having valves between said heater and tank, shall be provided with a water pressure relief valve set at a pressure of not more than fifty (50) pounds per square inch gauge pressure above the pressure of the water supply.

Every required pressure relief valve shall be an approved automatic type with drain. The pressure relief valve shall be installed in the cold water supply pipe between the pressure regulator or check valve and each heater or tank. If a pressure relief valve is located inside the building, a drain pipe shall extend therefrom to the outside of the building, with the end of the pipe not over two feet (2') above the ground and pointing downward. Such drain may terminate at other approved locations. Every relief valve shall be readily accessible. No shut-off valve of any kind shall be installed between the pressure relief valve and the tank it serves.

(g) **Reconditioned Water Heaters.** No parts used to repair or recondition gas water heaters shall differ in type,

make, or construction under which such gas water heater was orginally approved. Defective parts or material must be replaced in kind in order to validate the conditions of approval as specified in this Chapter.

(h) **Venting.** Water heaters shall be connected to a vent and vent connection meeting the requirements of Chapter 37.

(i) **Tubing Connectors.** Tubing connectors shall comply with Section 5101 (f).

Incinerators

Sec. 5108. (a) **General.** Incinerators for the reduction of refuse, garbage, or other waste materials shall be installed in accordance with the provisions of this Section. Materials and structural design shall meet the requirements of Part VI of this Chapter.

(b) **Small Domestic Type.** Incinerators of small uninsulated domestic type installed indoors shall be constructed, mounted, installed, and vented according to the applicable requirements for solid or liquid fuel-burning room heaters, as specified in Section 5106, except that mounting shall be on an incombustible and fire-resistive floor, and minimum clearances to combustible material shall be thirty-six inches (36") above, forty-eight inches (48") in front, and thirty-six inches (36") in back and at sides. The requirements of this Subsection shall also apply to incinerators installed as a part of other appliances.

Incinerators of small domestic type, or those that are a part of another appliance, that have been tested and approved by a nationally recognized testing agency and approved for installation on a combustible floor or with lesser clearances shall be installed in accordance with the conditions of such approval and shall be connected to a Type "A" flue or vent complying with the requirements of Chapter 37.

Outdoor incinerators of small domestic type shall be constructed and located to meet the approval of the Chief of the Fire Department.

(c) **Incinerators Using the Flue as a Refuse Chute.** Incinerators in which no fuel other than normal refuse, except a gas flame or similar means to accomplish ignition, is used for combustion, and in which the chute and smoke flue are identical, shall have the enclosing walls of the combustion chamber constructed of clay or shale brickwork not less than four inches (4") thick when there is a horizontal grate area of not more than nine square feet (9 sq. ft.) and not less than eight inches (8") thick when there is a horizontal grate area exceeding nine square feet (9 sq. ft.) and, in each case, a lining of firebrick not less than four inches (4") thick, with an air space, in the case of the thicker wall, between the clay or shale brick and the firebrick sufficient to provide for expansion and contraction.

The combined chute and flue shall be constructed as required for incinerator chimneys in Section 3703(e). Such chute and flue shall be constructed straight and plumb, and finished smooth on the inside. All flues shall terminate in a

Incinerators (Cont'd.)

substantially constructed spark arrester having a mesh not exceeding three-quarter inch (¾").

Firebrick shall be laid in fire clay mortar.

Service openings into the chute shall be equipped with approved self-closing hoppers so constructed that the opening is closed off while the hopper is being charged and that no part will project into the chute or flue. The area of the service opening shall not exceed one-third of the area of the chute or flue.

(d) **Commercial and Industrial Type Incinerators.** Commercial and industrial type incinerators designed to burn not more than 250 pounds of refuse per hour and having a horizontal grate area not exceeding nine square feet (9 sq. ft.) shall have the enclosing walls of the combustion chamber constructed of clay or shale brick not less than eight inches (8") thick with a lining of fire brick not less than four inches (4") thick, provided that the outer four inches (4") of clay or shale brickwork may be replaced by a steel plate casing not less than three-sixteenths inch (3/16") in thickness.

Commercial and industrial type incinerators of a size designed to burn more than 250 pounds of refuse per hour and having a grate area exceeding nine square feet (9 sq. ft.) shall have the enclosing walls of the combustion chamber constructed of clay or shale brick not less than eight inches (8") thick with a lining of fire brick not less than eight inches (8") thick, provided that the outer four inches (4") of clay or shale brickwork may be replaced by a steel plate casing not less than three-sixteenths inch (3/16") in thickness.

Combustion chamber walls shall be strongly braced and stayed with structural steel shapes, and the fire brick linings shall be laid in fire clay mortar.

Incinerators with their waste material bins or containers shall be located in a room or compartment used for no other purpose, or in a room devoted exclusively to boilers and heating plant. In either case such room shall be separated from the rest of the building by two-hour fire-resistive walls floors, and ceilings, with all openings equipped with single fire doors of a type required for Class "A" openings.

The flue connections or breechings from the combustion chamber shall be constructed of not lighter than 16 U. S. gauge metal when they do not exceed twelve inches (12") in diameter or greatest dimension and of 12 U. S. gauge metal when they exceed twelve inches (12") in diameter or greatest dimension. In addition they shall be lined with fire brick, laid in fire clay mortar, not less than two and one-half inches (2½") thick when they are between twelve inches (12") and eighteen inches (18") in diameter or greatest dimension, and not less than four and one-half inches (4½") thick when they are larger. If they lead into and combine with flue connections or breechings from other appliances, such other connections or breechings shall also be lined as required for direct flue connections, unless the cross-section area of the connection into which they lead is at least four times the area of the incinerator connection.

Incinerators (Cont'd.)

The clearance to woodwork or other combustible material or construction, on all sides of flue connections or breechings, shall be not less than thirty-six inches (36") provided that clearances may be modified as set forth in Table No. 51-A.

Refuse chutes shall not feed directly to the combustion chamber, but shall discharge into a room or bin enclosed and separated from the incinerator room by floors, ceilings, and walls of not less than two-hour fire-resistive construction. The opening through which material is transferred from such room or bin to the incinerator room shall be equipped with a fire door of a type required for Class "A" openings.

Refuse chutes shall rest on substantial incombustible foundations. The enclosing walls of such chutes shall consist of clay or shale brickwork not less than eight inches (8") thick or of reinforced concrete not less than six inches (6") thick. Such chutes shall extend to and not less than four feet (4') above the roof and shall be covered by a metal skylight glazed with single thick plain glass.

Service openings for chutes shall be located in separate rooms or compartments enclosed in walls or partitions, floors, and ceilings having a fire-resistance rating of not less than one hour. Such openings shall be equipped with fire doors or other approved devices of a type required for Class "B" openings.

(e) **Other Types.** Incinerators of types other than those regulated above shall be constructed and installed in accordance with the requirements of Section 5108 (d), except for special large capacity incinerators and refuse burners used in connection with saw mills and woodworking plants and except for other approved types which incinerators shall meet the approval of the Chief of the Fire Department.

Miscellaneous Domestic Appliances

Sec. 5109. (a) **Clearances.** Appliances so constructed that the burners or heating elements are not shielded by metal or other approved insulating material, shall have a minimum clearance of twelve inches (12") to any combustible material above the burner or heating element level. Appliances approved for installation at lesser distances from combustible material may be installed with clearances for which they are approved. Appliances having open flames shall not be installed where the vertical clearance to combustible construction is less than thirty-six inches (36"). A two-foot vertical clearance over open flame gas appliances is permitted if the underside of the combustible construction exposed to flame is protected with a minimum of one-quarter-inch (¼") asbestos millboard covered with 28 U. S. gauge or heavier sheet metal covering, and the projection extends a minimum of nine inches (9") beyond the outer dimensions of the appliance. Reduced clearances shall be as set forth in Table No. 51-A.

(b) **Ranges and Hot Plates.** Ranges or hot plates shall not be installed in rooms intended to be used for sleeping purposes. There shall be installed in the wall or ceiling, approximately over the cooking facilities, a ventilating opening

Miscellaneous Domestic Appliances (Cont'd.)

with a minimum area of eight inches by six inches (8" x 6"), connected by an incombustible ventilating duct free to the outside of the building. The ventilating duct for each kitchen shall have a minimum cross-sectional area of twenty-eight square inches (28 sq. in.). An approved forced draft system of ventilation may be substituted for the natural draft ventilating system.

Combination type gas and solid fuel ranges and trash burner ranges, must be vented to a Type "A" chimney constructed in accordance with the provisions of this Chapter for use by trash burners. Solid top type gas ranges and built-in gas circulator type ranges shall be vented to an approved Type "B" gas vent or Type "A" chimney. Gas ranges having a griddle and open type top burners are not classed as solid top ranges.

(c) **Domestic Clothes Dryers.** Clothes dryers shall not be installed in bathrooms or rooms used for sleeping purposes. Venting of gravity type clothes dryers shall conform to the vent requirements of Chapter 37.

Where adequate room ventilation is not provided, blower type clothes dryers shall be exhausted in such a manner as to insure that the moisture is carried to the outside air.

Commercial Food Preparation Equipment

Sec. 5110. (a) General. The provisions of this Subsection shall apply to ranges, broilers, ovens, and other miscellaneous appliances of a type generally used in hotel, restaurant, and institutional kitchens. Such appliances shall be installed level on a firm foundation. Rooms containing commercial food preparation equipment shall be provided with sufficient openings to the outside air to prevent accumulation of hot air over appliances and to prevent lowering of atmospheric pressure due to air exhausted by mechanical means and shall in no case provide less than four air changes per hour.

(b) **Mounting of Appliances.** Ranges, broilers and ovens may be installed with their bases or legs on unprotected combustible floors if they are approved for such installation.

Ranges, broilers and ovens not approved for installation directly on unprotected combustible floors shall be mounted on floors of concrete or other fire-resistive construction, which shall have no combustible material on the underside thereof, and which shall extend not less than 12 inches (12") beyond the appliance on all sides and, where solid fuel is used, shall extend not less than eighteen inches (18") at the front or side where ashes are removed.

EXCEPTIONS: 1. Appliances with 18-inch legs. Appliances which are set on legs which provide not less than eighteen inches (18") open space under the base of the appliance, or which have no burners and no portion of any oven or broiler within eighteen inches (18") of the floor, may be mounted on combustible floors, provided there is at least one sheet metal baffle between the burners and the floor.

2. **Appliances with 8-inch legs.** Appliances which are set on legs which provide not less than eight inches (8") open space under the base of the appliance, may be mounted on combustible floors, provided the floor under

the appliance is protected with not less than one-quarter inch (¼") asbestos mill board covered with sheet metal of not less than 24 U. S. gauge. The above specified floor protection shall extend not less than six inches (6") beyond the appliance on all sides, and where solid fuel is used shall extend not less than eighteen inches (18") at the front or side where ashes are removed.

3. **Appliances with 4-inch legs.** Appliances which are set on legs which provide not less than four inches (4") open space under the base of the appliance, may be mounted on combustible floors, provided the floor under the appliance is protected with hollow masonry not less than four inches (4") in thickness, covered with sheet metal of not less than 24 U. S. gauge. Such masonry course shall be laid with ends unsealed and joints matched in such a way as to provide a free circulation of air through the masonry. Where solid fuel is used the floor for eighteen inches (18") beyond the front of the appliance or side where ashes are removed shall be protected with not less than one-fourth inch (¼") asbestos mill board covered with sheet metal of not less than 24 U. S. gauge, or with protection equivalent thereto.

4. **Appliances without legs on hollow tile.** Appliances may be mounted on combustible floors, provided the floor under the appliance is protected by two courses of four-inch (4") hollow clay tile or equivalent, with courses laid at right angles and with ends unsealed and joints matched in such a way as to provide a free circulation of air through such masonry courses, and covered with steel plate not less than three-sixteenth inch (3/16") in thickness. Where solid fuel is used the floor for eighteen inches (18") beyond the front of the appliance or side where ashes are removed shall be protected with not less than one-fourth inch (¼") asbestos mill board covered with sheet metal of not less than 24 U. S. gauge, or with protection equivalent thereto.

(c) **Clearances for Approved Appliances.** Ranges, broilers and ovens shall be installed to provide a clearance to walls of combustible material not less than that specified in the conditions of approval. Approved gas-fired appliances shall be installed not less than six inches (6") from combustible construction except that at least a two-inch (2") clearance shall be maintained between the flue box or draft hood and combustible construction. Reduced clearances shall be as set forth in Table No. 51-A.

(d) **Clearances for Unapproved Appliances.** Ranges, broilers and ovens not approved for specific clearances shall be installed to provide a clearance to walls of combustible construction of not less than eighteen inches (18"). Reduced clearances shall be as set forth in Table No. 51-A.

(e) **Wall Protection Above Cooking Top.** Where a wall of combustible construction adjacent to the cooking top of an appliance is not shielded by a high shelf or ventilating system, the wall shall be protected by sheet metal of not less than 28 U. S. gauge over one-quarter inch (¼") asbestos mill

Commercial Food Preparation Equipment (Cont'd.)

board extending at least twenty-four inches (24") above the surface of the cooking top.

(f) **Hoods. 1. When required.** Restaurant type ranges, fry kettles, candy kettles, cruller furnaces, and appliances for the frying of bakery or confectionery products, shall be provided with ventilating hoods and ducts to the outside air to take off the smoke, gases and vapors, unless such appliances are of the enclosed type and are vented in an approved manner.

2. Location. Such hoods shall not be raised more than seven feet (7') above the floor. Hoods shall be of sufficient depth to extend at least six inches (6") beyond all sides of units served.

3. Construction. Such hoods and their ducts shall be constructed of incombustible materials with tight unsoldered joints and if of metal shall be of not less than 24 U.S. gauge copper, galvanized iron or other equivalent corrosion-resistant ferrous metal. Hood ducts shall not be connected with any other ventilating system, but connect into flues or stacks used for the same purpose and conforming to the requirements for smoke flues. The hood shall have a grease trough extending around the perimeter, draining into a grease container outside the hood. A sufficient number of cleanout openings shall be provided in horizontal runs of every duct to permit cleaning of all portions of the interior of such areas where grease is likely to condense and trap.

4. Grease Extraction. Approved grease filters or grease baffles shall be installed at the inlet of the exhaust system.

5. Exhaust Capacity. Exhaust duct systems shall be so designed as to create a conveying air velocity of not less than fifteen hundred feet (1500') and not more than twenty-two hundred feet (2200') per minute.

6. Clearances. Such hoods and their ducts shall be installed to provide a clearance to woodwork or other combustible material whether plastered or unplastered of not less than eighteen inches (18"). Reduced clearances shall be as set forth in Table No. 51-A. The ducts shall not pass through combustible walls or partitions unless they are protected at the point of passage as specified for smoke pipes in Section 3709.

7. Gas Appliance Vents. Vents for this type of equipment may be of Type C and shall be sized as specified in Section 3706 (c), Paragraph 5.

Where gravity type hoods are used, vents from the appliance shall extend a minimum of six inches (6") above the lower perimeter of the hood and shall be opened to allow flue gases to mix with cooler air before entering the ventilating system.

Where forced draft type hoods or systems are used, vents from appliances shall be installed so that the flue gases will mix with cooler air before entering the ventilating system.

(g) **Gas Counter Appliances. 1. Vertical Clearance.** A vertical distance of not less than forty-eight inches (48")

shall be provided between the top of all commercial hot plates and griddles and combustible construction.

Commercial Food Preparation Equipment (Cont'd.)

2. **Approved Appliances.** Approved gas counter appliances such as commercial hot plates and griddles, food and dish warmers, coffee brewers and urns, waffle bakers and hot water immersion sterilizers, when installed on combustible surfaces shall be set on their own bases or legs, and shall be installed with a minimum horizontal clearance of six inches (6″) from combustible construction.

3. **Untested Appliances.** Untested commercial hot plates and griddles shall be installed with a horizontal clearance from combustible construction of not less than eighteen inches (18″). Untested gas counter appliances such as coffee brewers and urns, waffle bakers and hot water immersion sterilizers shall be installed with a horizontal clearance from combustible construction of not less than twelve inches (12″). Gas counter appliances may be installed with lesser clearances than specified above where the combustible construction is protected as set forth in Table No. 51-A. Untested food and dish warmers shall be installed with a horizontal clearance from combustible construction of not less than six inches (6″). Combustible surfaces under untested gas counter appliances shall be protected in an approved manner.

(h) **Steam and Hot Food Tables.** Burners of gas-fired steam tables shall be located at least twelve inches (12″) above any wood floor with a 24 U. S. gauge sheet metal baffle located between burners and floor. Pan containing water shall be separated by at least one inch (1″) from metal body of steam table. Sufficient openings of one square inch (1 sq. in.) to 1000 B.t.u. shall be provided in upper section of body of steam table to permit escape of products of combustion, wherever steam table is fully enclosed, such as where sliding doors are fitted to body of unit. Baffle or shelving shall be perforated with openings of one square inch (1 sq. in.) per 1000 B.t.u. for air to support combustion. Bodies of hot food tables shall be insulated with at least one-quarter inch (¼″) of approved insulation.

(i) **Dishwashers.** Gas-fired dishwashers having burners within eight inches (8″) of any wood floor or combustible base shall be mounted on 24 U. S. gauge sheet metal insulated with one-fourth-inch (¼″) asbestos mill board. The back and ends shall have at least six inches (6″) clearance from combustible partitions or walls providing the walls or partitions are covered with 24 U. S. gauge sheet metal. Combustible shelving under dishtable shall be at least eighteen inches (18″) away from ends of unit. Immersion type dishwashers located in basements or sub-floor rooms shall have hoods installed not less than six feet six inches (6′ 6″) above the floor and in no case shall the dishwasher hood area be smaller than the top of the dishwasher. Tank type dishwashers located in basements or sub-floor rooms shall be provided with duct openings and these shall be connected to a ventilating system.

(j) **Portable Gas Baking and Roasting Ovens.** Approved

portable gas baking and roasting ovens shall be installed at least six inches (6") from combustible construction, except that at least a two-inch (2") clearance shall be maintained between the flue box or draft hood and combustible construction. Untested portable baking and roasting ovens shall be installed with clearances to combustible construction of not less than eighteen inches (18"). Reduced clearances shall be as set forth in Table No. 51-A.

Industrial Heating Equipment

Sec. 5111. (a) Construction. Industrial heating equipment shall be substantially constructed in a workmanlike manner.

(b) Installation, Mounting and Clearances. Appliances shall be installed, mounted and have clearances so as not to raise the temperature of nearby combustible materials to temperatures not exceeding 90° F. plus room temperature. The manufacturer or installer, or both, shall supply the Building Official with the necessary information regarding installation, mounting and clearances to enable the above conditions to be met.

(c) **Venting.** Industrial heating equipment shall be connected to a vent, flue or chimney complying with the provisions of Chapter 37, except that the sizes of the vent flues or chimneys for commercial and industrial type heating equipment, shall be determined in accordance with the manufacturer's specifications.

(d) **Ventilation.** Rooms containing industrial heating equipment shall be provided with means of ventilation adequate to prevent excessive accumulation of hot air over or near the appliance.

Heating and Power Boilers

Sec. 5112. Construction. Heating boilers shall be constructed in accordance with nationally recognized standards.

Fuel Supply and Storage Facilities

Sec. 5113. (a) Gas Piping. Gas piping supplying appliances, together with fittings, valves, and other appurtenances, shall be constructed and installed in accordance with nationally recognized safety standards.

(b) **Oil Burners and Oil Supply.** Oil-burning equipment, which shall be held to mean oil burners, piping, pumps, controls, and other accessories, shall be constructed and installed in accordance with the U.B.C. Standard No. 9-1.

No fuel oil supply tank shall be permitted attached to or made an integral part of an appliance unless it is included within the scope of approval of the appliance as specified in Section 5101 (b). Every tank not attached to or constituting an integral part of an appliance shall be constructed and installed according to U.B.C. Standard No. 9-1.

(c) **Liquefied Petroleum Gases.** Fuel containers, piping, fittings, valves, and accessories used in supplying appliances with liquefied petroleum gases shall be constructed and installed in accordance with U.B.C. Standard No. 9-2.

Heat-producing appliances using liquefied petroleum gas or liquefied gas-air mixtures equipped with pilots for automatic ignition, except range top burners, shall be equipped with an approved automatic pilot light controlled shut-off valve that will atuomatically shut off gas to both burner or burners and pilot light when the pilot light is extinguished.

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